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The Power of Focal Points Is Limited: Even Minute Payoff Asymmetry May Yield Large Coordination Failures

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Since Schelling, it has often been assumed that players make use of salient decision labels to achieve coordination. Consistent with previous work, we find that given equal payoffs, salient labels yield frequent coordination. However, given even minutely asymmetric payoffs, labels lose much of their effectiveness and miscoordination abounds. This raises questions about the extent to which the effectiveness of focal points based on label salience persists beyond the special case of symmetric games. The patterns of miscoordination we observe vary with the magnitude of payoff differences in intricate ways that suggest nonequilibrium accounts based on "level-k" thinking and "team reasoning." (JEL C72, C92*)*

Thomas C. Schelling's (1960) seminal experiments are an important landmark in the study of coordination. Schelling asked subjects to choose independently and without communication where in New York City they would try to meet one another. Those who chose the same meeting location as their partner would receive a positive (hypothetical) payoff, equal to that of their partner's and independent of the specific location. Those who did not would receive a zero payoff. Despite the plethora of possible meeting locations, a majority of subjects chose Grand Central Station, which was the most salient traffic hub in New York at the time, yielding a high expected coordination rate. On the basis of his results, Schelling concluded that even though traditional game theory allows no role for the salience of decision labels, many situations "provide some clue for coordinating behavior, some focal point for each person's expectations of what the other expects him to be expected to do" (1960, 57). In this paper we use the term "focal point" in the sense of the passage just quoted, to refer to coordination brought about (at least partly) by exploiting the salience of decision labels.[1]

Much experimental work has since corroborated and extended Schelling's results on the effectiveness of focal points. In particular, a number of researchers have observed high expected coordination rates in games with salient decision labels and symmetric, constant payoffs (Judith Mehta, Chris Starmer, and Robert Sugden 1994a, b; Michael Bacharach and Michele Bernasconi 1997; Nicholas Bardsley et al. 2006). Furthermore, since Schelling's investigation, it has usually been assumed that players can also exploit the salience of decision labels to achieve coordination in games with moderately asymmetric payoffs. As Sugden (1995, 548) states, "[a]lthough it

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[1] Schelling also considered focal points derived entirely from the payoff structure, or from preplay communication or precedents based on shared history. Traditional game theory excludes decision labels and other aspects of the framing of the game from consideration by fiat. It focuses instead on the payoff structure, which leads to payoffs-based coordination refinements like John C. Harsanyi and Reinhard Selten's (1988) notions of risk- and payoff-dominance.

is crucial to the concept of a focal point that the players have some degree of common interest, focal-point reasoning seems to be applicable to games in which there are also conflicts of interest—provided those conflicts are not too great." Schelling himself suggested that labels would have a strong influence, even in what he called situations of "divergent interests." Nevertheless, to our knowledge, the robustness of focal points to payoff asymmetries has not been tested.[2]

This paper reports experiments that compare responses (between subjects) to coordination games with symmetric, constant payoffs ("symmetric games" from now on) and closely related games with asymmetric payoffs ("asymmetric games"), in the latter case with or without salient decision labels.[3] Although learning may converge to equilibrium over time, we study subjects' initial responses, which reveal their strategic thinking most clearly. Each subject participated in only one of our treatments, and played its game only once.

The asymmetric games in our main ("*X-Y*," described below) treatments have payoff structures like Battle of the Sexes. As in Battle of the Sexes, the decisions have a commonly understood labeling whose implications for salience ("label salience," which we assume favors the same decision for both player roles) reinforce the intrinsic salience of the game's payoffs ("payoff salience") in one player role, but oppose it in the other. For example, in Battle of the Sexes, assuming the stereotypical preferences, payoff salience favors ballet for the woman but fights for the man. Thus, in a society in which the label "ballet" is more salient than "fights" (for both men and women), label salience reinforces payoff salience for women but opposes it for men.

Our analysis begins with a pilot experiment using a game we call *Chicago Skyscrapers*, meant to mimic the most important features of Schelling's New York example while allowing us to examine the robustness of his findings to payoff asymmetries. Thus, following Schelling, we asked participants to consider hypothetical payoffs in this game (the experiments we report later all used real payoffs). In particular, in each of three treatments, University of Chicago students were asked to choose, independently, between two locations, the *Sears Tower*, which is one of the tallest buildings in the world and a recognizable Chicago landmark, and the little-known *AT&T Building* across the street from the Sears Tower. If a matched pair of subjects both chose *Sears Tower*, Player 1 (henceforth "P1") would receive $\$a$ and Player 2 ("P2") would receive $\$b$; if both chose *AT&T* the assignment of payoffs to players would be reversed; and if the subjects chose different locations, neither would receive anything. One of our *Chicago Skyscrapers* treatments implemented a symmetric game with $a = b = \$100$; a second implemented a minutely asymmetric game in which $a = \$100$ and $b = \$101$; and a third implemented a moderately asymmetric game with $a = \$100$ and $b = \$110$.

In the symmetric treatment, as anticipated, 90 percent of our 60 subjects (pooled across player roles, as their symmetry suggests) chose the label salient *Sears Tower*, thereby achieving an expected coordination rate of 82 percent. In the minutely asymmetric treatment, by contrast, *Sears Tower* lost much of its power as a focal point. Only 60 percent of 99 subjects chose *Sears*

[2] The alternative sources of focal points mentioned in footnote 1 have been studied experimentally. Russell W. Cooper et al. (1990); John B. Van Huyck, Raymond C. Battalio, and Richard O. Beil (1990, 1991) (see also Crawford 1995); and Paul G. Straub (1995) studied coordination via payoffs-based notions, including risk- and payoff-dominance. Cooper et al. (1989, 1992a); Van Huyck, Ann B. Gillette, and Battalio (1992), and Jordi Brandts and W. Bentley MacLeod (1995) studied preplay communication or mediation via cheap talk. Brandts and Charles Holt (1993), Gerard Cachon and Colin F. Camerer (1996), Van Huyck, Battalio, and Beil (1993) (see also Crawford and Bruno Broseta 1998), and Andreas Blume and Gneezy (2002) studied coordination via forward induction. Van Huyck, Battalio, and Beil (1990, 1991), Crawford (1995), Van Huyck, Battalio, and Frederick W. Rankin (1997), Van Huyck, Joseph Cook, and Battalio (1997), and Camerer and Teck-Hua Ho (1998) studied coordination via learning. Blume and Gneezy (2002) studied coordination via historical precedent generated endogenously within a relationship, testing Crawford and Hans Haller's (1990) and Blume's (2000) theory of optimal coordination in repeated games. Crawford (1997, 1998) and Camerer (2003) survey the literature.

[3] All of our games have payoff structures that are symmetric across player roles. We use "asymmetric" to refer to the relation between payoffs and labeling, as explained below.

Table 1—*X-Y* Games

		P2	
	P1	*X*	*Y*
Symmetric, Labeled ("SL")	*X*	5, 5	0, 0
	Y	0, 0	5, 5
Asymmetric, Slight Asymmetry, Labeled ("ASL")	*X*	5, 5.1	0, 0
	Y	0, 0	5.1, 5
Asymmetric, Moderate Asymmetry, Labeled ("AML")	*X*	5, 6	0, 0
	Y	0, 0	6, 5
Asymmetric, Large Asymmetry, Labeled ("ALL")	*X*	5, 10	0, 0
	Y	0, 0	10, 5
Asymmetric, Slight Asymmetry, Unlabeled ("ASU")	*X*	5, 5.1	0, 0
	Y	0, 0	5.1, 5
Asymmetric, Moderate Asymmetry, Unlabeled ("AMU")	*X*	5, 6	0, 0
	Y	0, 0	6, 5

Tower, 58 percent of the 50 subjects whose payoff for coordinating there was $101 and 61 percent of the 49 subjects whose payoff was $100. Subjects in the minutely asymmetric treatment therefore achieved an expected coordination rate of 52 percent, only slightly higher than the approximately 50 percent rate in a mixed-strategy equilibrium. In the moderately asymmetric treatment, *Sears Tower* lost even more of its focal power. Only 48 percent of 58 subjects chose *Sears Tower*, 47 percent of the 30 subjects whose payoff for coordinating there was $110 and 50 percent of the 28 subjects whose payoff was $100. These subjects again achieved an expected coordination rate of about 50 percent.

In sum, as in previous experiments, focal points based on label salience yielded high coordination rates in symmetric games, where payoff salience is neutral. But in asymmetric games label salience was no longer effective, and even minute payoff asymmetries yielded pronounced coordination failures. These results raise questions about the extent to which the effectiveness of focal points based on label salience persists beyond the special case of symmetric games. To frame the issue, imagine that subjects in the minutely asymmetric *Chicago Skyscrapers* game had been told (correctly) that ignoring the trivial payoff differences and trying to find a clue that would allow them to maximize the probability of coordination was the best way to maximize their expected earnings. Our results for the symmetric game suggest that they would then have chosen *Sears Tower* with high frequency and achieved much higher earnings. But left on their own, they did not ignore the payoff differences. Instead, they seemed to ignore the labels, even though this led to frequent miscoordination. Why didn't subjects "freely dispose" of the negligible payoff asymmetry and use the salience of *Sears Tower* to coordinate?

To answer this question and to examine whether our *Chicago Skyscrapers* finding that payoff asymmetries interfere with focal points extends to other settings, we studied the impact of label salience in symmetric and asymmetric games in more detail and propose a theory to explain this result. We next ran an experiment analogous to *Chicago Skyscrapers* but with paid subjects. We ran six such treatments, some with abstract decision labels, *X* and *Y*, and some not, with varying payoff differences, and each with a separate subject group (Table 1). In the "labeled *X-Y*" treatments, if a matched pair of subjects both chose *X*, P1 would receive $*a* and P2 $*b*; if both subjects chose *Y*, the assignment of payoffs to players would be reversed; and if the subjects chose decisions with different labels, neither would receive anything. In the corresponding "unlabeled" treatments, subjects chose between allocations that were described simply as "P1 receives $*a* and P2 receives $*b*" and "P1 receives $*b* and P2 receives $*a*," with no reference to *X* and *Y*. If a pair

Table 2—Payoffs and Observed Play in the Six *X-Y* Treatments[a]

	Symmetric labeled (SL)	Asymmetric slight labeled (ASL)	Asymmetric moderate labeled (AML)	Asymmetric large labeled (ALL)	Asymmetric slight unlabeled (ASU)	Asymmetric moderate labeled (AMU)
Payoffs for coordinating on "*X*" or its analog (lower P1 payoff, higher P2 payoff) in unlabeled games	\$5, \$5	\$5, \$5.10	\$5, \$6	\$5, \$10	\$5, \$5.10	\$5, \$6
Payoffs for coordinating on "*Y*" or its analog in unlabeled games	\$5, \$5	\$5.10, \$5	\$6, \$5	\$10, \$5	\$5.10, \$5	\$6, \$5
N	50 (P1s and P2s pooled)	23 P1s 25 P2s	30 P1s 31 P2s	11 P1s 10 P2s	24 P1s 24 P2s	23 P1s 23 P2s
N (%) choosing "*X*"	38 (76%) P1s and P2s	18 (78%) P1s 7 (28%) P2s	10 (33%) P1s 19 (61%) P2s	4 (36%) P1s 6 (60%) P2s	15 (63%) P1s 9 (38%) P2s	9 (39%) P1s 14 (61%) P2s
Expected coordination rate (expected mixed-strategy equilibrium coordination rate)	64% (50.0%)	38% (50.5%)	46% (49.6%)	47% (44.4%)	47% (50.5%)	48% (49.6%)
Expected earnings P1s	\$3.18	\$1.90	\$2.57	\$3.64	\$2.38	\$2.62
Expected earnings P2s	\$3.18	\$1.91	\$2.51	\$3.44	\$2.38	\$2.62

[a] P1s and P2s are theoretically poolable in SL because SL subjects could observe no difference in their roles.

chose the same allocation, that allocation was enforced; and if they chose different allocations, neither would receive anything.[4]

We anticipated that *X* would be more salient than *Y*, because "*X* marks the spot" and *X* precedes *Y* in the alphabet. Indeed, our *X-Y* results replicated the broad features of our *Chicago Skyscrapers* results. The coordination rate was almost as high in the labeled symmetric *X-Y* game ("SL" in Tables 1 and 2) as in the symmetric *Chicago Skyscrapers* game and in Schelling's (1960) and Mehta, Starmer, and Sugden's (1994a, b) similar treatments, with *X* enjoying almost the same label salience as *Sears Tower*. Nevertheless, despite the strong and beneficial influence of labels in the symmetric game, the coordination rate was again much lower in the labeled asymmetric games, with even minute payoff asymmetry yielding large coordination failures.

Thus, our *X-Y* games approximately replicated the dual pattern from our *Chicago Skyscrapers* games of pronounced coordination under symmetry but frequent miscoordination under asymmetry. Moreover, payoff salient decisions were approximately equally frequent in each labeled *X-Y* asymmetric treatment and in its unlabeled counterpart, for both P1s and P2s. That is, asymmetric labeled games yielded play essentially equivalent to that in their unlabeled counterparts. This observation starkly highlights the notion that labels lose much of their effectiveness given asymmetry.

Our *X-Y* results had an additional surprising feature that did not show up clearly in our *Chicago Skyscrapers* treatments: the pattern of miscoordination reversed as the asymmetric *X-Y* games progressed from small to large payoff differences, with most subjects in both roles favoring their

[4] The instructions are provided in a Web Appendix (available at http://www.aeaweb.org/articles.php?doi=10.1257/aer.98.4.1443). For convenience, we use the term "*X-Y*" to refer even to the unlabeled games. Our *X-Y* games were presented to subjects as "stories" involving payoffs, without matrix representations, to avoid distortion via uncontrolled presentation effects such as "top-left" bias.

partners' payoff salient decisions with minutely asymmetric payoffs but their own payoff salient decisions in the treatments with larger differences. As explained below, this reversal is an important clue to identifying a model that explains why payoff asymmetry so sharply limits the power of focal points in our *Chicago Skyscrapers* and *X-Y* treatments.

Our main goal in this paper is to corroborate and report our finding that focal points based on salient labels may lose much of their power when label salience is opposed by payoff salience, however minute the payoff asymmetry on which it is based. We also explore the limits of this finding and begin to construct a theoretical explanation, as needed to assess its generality.

Our proposed theoretical explanation of subjects' responses to our *X-Y* treatments is a structural nonequilibrium model based on level-*k* thinking, a leading example of the kind of model needed to explain the reversal of the pattern of miscoordination with increasing payoff asymmetries. Level-*k* models have strong experimental support in describing initial responses to games in other settings. Our model builds on Crawford and Nagore Iriberri's (2007a) level-*k* analysis of the experimental results for "hide-and-seek" and related games with nonneutrally framed locations of Ariel Rubinstein and Amos Tversky (1993), Rubinstein, Tversky, and Dana Heller (1996), Rubinstein (1999), Barry O'Neill (1987), and Amnon Rapoport and Richard Boebel (1992).[5]

Like previous level-*k* models, our model allows behavior to be heterogeneous in a structured way. Specifically, we assume that players in either role follow one of two decision rules or *types* (as they are called in this literature), drawn from a common distribution. The types are called *L1* (*L* for "level") and *L2*. *L1* anchors its beliefs in a nonstrategic *L0* type and best responds to them. *L2* best responds to *L1*. The anchoring *L0* type represents *L1* players' beliefs about other players' instinctive reactions to label and payoff salience, *L2*'s beliefs about *L1*'s beliefs, and so on. *L1* and *L2* reflect players' strategic responses to their beliefs. Types *L1* and *L2* have accurate models of the game and are rational in that they choose best responses to beliefs. Their only departure from equilibrium is in replacing its perfect model of others' decisions with simplified models that avoid the complexity of equilibrium analysis.

In applications, the population type frequencies are treated as behavioral parameters, and are usually estimated econometrically from the current dataset or translated from previous work. The estimated distributions tend to be stable across games, with most weight on *L1* and *L2*. Thus, the anchoring *L0* type exists mainly in the minds of higher types. Here, we simplify by limiting the distribution to *L1* and *L2*, assuming the population frequencies of *L0* and *L3*, etc., are zero.

Although *L0* is assumed to have zero frequency, its specification is the main issue that arises in defining a level-*k* model and the key to the model's explanatory power. We assume that *L0* responds to both label and payoff salience, but with what we will call a "payoffs bias" that favors payoff over label salience, other things equal. Such an *L0*, with a behaviorally plausible mixture of *L1* and *L2* players, yields a model that gracefully explains the high coordination rates in our symmetric *X-Y* game, the much lower rates in our asymmetric games, the similarities in subjects' responses to asymmetric labeled games and their unlabeled counterparts, and the surprising reversal of the pattern of miscoordination with increasing payoff asymmetries.[6]

To further explore the limits of our finding that focal points based on salient labels may lose their power when label salience is opposed by payoff salience, we then consider a group of

[5] We adapt Crawford and Iriberri's model of players' responses to label salience in zero-sum games with neutral payoffs to our coordination games with nonneutral payoffs and interactions between payoff and label salience. Crawford and Iriberri's (2007a) analysis builds, in turn, on level-*k* models of initial responses to games introduced by Dale O. Stahl, II, and Paul Wilson (1994, 1995) and Rosemarie Nagel (1995) and further developed by Ho, Camerer, and Keith Weigelt (1998); Michael Bacharach and Stahl (2000); Miguel Costa-Gomes, Crawford, and Broseta (2001); Camerer, Ho, and Juin-Kuan Chong (2004); Ernan Haruvy and Stahl (2004); Gneezy (2005); and Costa-Gomes and Crawford (2006).

[6] We focus on our *X-Y* games because the *Chicago Skyscrapers* games were played for hypothetical payoffs, but a similar level-*k* model would also track most of our *Chicago Skyscrapers* results.

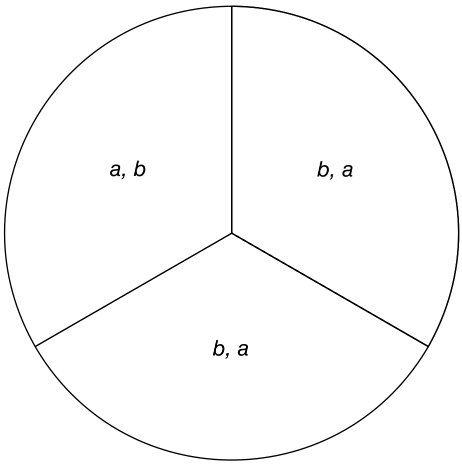

Figure 1. Visual Presentation Used in the Pie Game

Note: The letters a and b represent the payoffs to player 1 and 2, respectively, if both players coordinate on the same slice.

games with different framing and a richer set of relationships between label and payoff salience, which we call *Pie* games. In these games, subjects are given a visual representation as in Figure 1, which includes two upper "pie slices" that are shaded (which we call L and R, respectively) and a bottom slice that is always unshaded (which we call B).[7] Each of two players simultaneously selects one of the three slices. If the players select the same slice they each receive a positive payoff, but if they select different slices they receive nothing. We again vary the payoffs across eight symmetric and asymmetric treatments (Table 4).

Our results for *Pie* games generally replicate our *Chicago Skyscrapers* and *X-Y* finding that focal points based on salient labels are powerful with symmetric payoffs, but can lose their power with asymmetric payoffs when label salience is opposed by payoff salience. In most of our *Pie* treatments, a simple adaptation of the level-k model proposed for our *X-Y* games yields a plausible explanation of most subjects' responses. In other *Pie* treatments, however, no sensible level-k account seems possible; and in some of these treatments focal points based on label salience remain powerful even with asymmetric payoffs.

We suggest that coordination can persist in such treatments with asymmetric payoffs because their structure facilitates appeal to a notion of collective rationality called "Schelling salience" or "team reasoning" (Crawford and Haller 1990; Mehta, Starmer, and Sugden 1994a, b; Sugden 1995; Bacharach and Bernasconi 1997; Bacharach 1999; Blume 2000; Bardsley et al. 2006). In this respect, our analysis parallels the analyses of Mehta, Starmer, and Sugden (1994a, b) and Bardsley et al. (2006), who found evidence of team reasoning in some of their treatments.

In team reasoning, players begin by asking themselves, independently, if there is a decision rule that would be better for both than individualistic rules, if both players followed the better rule. In our *Chicago Skyscrapers* and *X-Y* games, for instance, ignoring payoff salience and choosing according to label salience is such a rule, though, to reiterate we do not invoke team reasoning in our analysis of the results from those treatments. If there is such a better rule, players follow it; and if not they follow their usual individualistic rule.

Overall, our results suggest a synthesis of level-k thinking and team reasoning in which team reasoning supplements or supplants level-k thinking in some settings. Team reasoning is unhelpful in settings like our asymmetric unlabeled *X-Y* games. It is potentially helpful but does not emerge with any frequency in our experiments in most other settings, such as our asymmetric *X-Y* games (labeled or unlabeled) and most of our *Pie* games. But in some of our *Pie* games, the results seem explicable only via team reasoning. Although our results and analysis provide some guidance on what kinds of setting favor level-k thinking and what

[7] This game is based on a game used in Andreas Blume and Gneezy's (2000) experimental test of Crawford and Haller's (1990) and Blume's (2000) theories of optimal learning in repeated coordination games.

kinds favor team reasoning, as indicated below, we leave a full answer to this question for future work. Our analysis elucidates common elements of strategic thinking that should help to predict the effectiveness of focal points based on label or payoff salience in other settings, with or without payoff asymmetry.

The rest of the paper is organized as follows. Section I reports our results for *X-Y* games, introduces our level-*k* model, and uses it to analyze the *X-Y* results. Section II reports our results for *Pie* games and analyzes them, showing to what extent they can be understood via a level-*k* model, team reasoning, or both. Section III is the conclusion.

I. *X-Y* Games

A. *The Games*

Table 1 lists our *X-Y* treatments. In all such treatments, the two players' rankings of pure-strategy equilibria are entirely opposed. Recall that in the labeled treatments, if a matched pair of subjects both chose *X*, P1 received \$*a* and P2 \$*b*; if both chose *Y* the assignment of payoffs was reversed; and if they chose decisions with different labels, neither received anything. In the unlabeled treatments, the payoff structures were the same, but subjects chose between allocations that were described simply as "P1 receives \$*a* and P2 receives \$*b*" and "P1 receives \$*b* and P2 receives \$*a*," with no reference to *X* and *Y*. We identify our *X-Y* treatments via acronyms in which the first letter refers to the payoff structure, the second (in asymmetric games) identifies the extent of any asymmetry, and the last letter indicates labeling. The treatments included a Symmetric Labeled game ("SL") in which $a = b = \$5$; Asymmetric games, Labeled or Unlabeled, in which the payoff asymmetry was Slight, $a = \$5$ versus $b = \$5.10$ ("ASL" and "ASU"); Asymmetric games, Labeled or Unlabeled, in which the payoff asymmetry was Moderate, $a = \$5$ versus $b = \$6$ ("AML" and "AMU"); and, finally, an Asymmetric Labeled game with Large payoff asymmetry, $a = \$5$ versus $b = \$10$ ("ALL").

B. *Results*

Table 2 presents our *X-Y* results, which replicated the broad features of our *Chicago Skyscrapers* results. The coordination rate in the symmetric *X-Y* treatment (SL) was quite high (64 percent versus the 82 percent in the symmetric *Chicago Skyscrapers* game), with the label *X* enjoying almost the salience of *Sears Tower*. Nevertheless, the coordination rate was much lower in every one of our labeled asymmetric *X-Y* games (ALS, ALM, and ALL).

Furthermore, subjects in the labeled asymmetric games seemed to focus on payoffs almost to the exclusion of labels. In every such treatment, the frequencies of payoff salient decisions were nearly the same for both P1s and P2s. Further, the frequencies of payoff salient decisions in the unlabeled asymmetric games ASU and AMU were close, for both P1s and P2s, to those in their labeled counterparts ASL and AML. As a result, the expected coordination rate is high in the symmetric game but much lower in every asymmetric game, even those with slight payoff asymmetries.

Two aspects of the patterns of miscoordination are noteworthy. First, although there were always large coordination failures in the asymmetric games, the pattern of miscoordination completely reversed as the games progressed from small (ASL) to large (AML and ALL) payoff asymmetries. In ASL there was a large drop, relative to SL, in the frequency with which subjects for whom payoff salience *reinforced* label salience (column players in Table 1, P2s in Table 2) chose *X*, coupled with a slight increase in the frequency with which their partners chose *X*. As a result, in ASL most P1s and P2s favored their partners' payoff salient decision.[8] This yielded a coordination rate of 38 percent, much lower than the 64 percent in SL, replicating our *Chicago Skyscrapers* result. In AML and ALL, by contrast, there was a large drop, relative to SL, in the frequency with which subjects for whom payoff salience *opposed* label salience (row players, P1s) chose *X*, coupled with a modest decrease in the frequency with which their partners chose *X*. As a result, in AML and ALL, most P1s and P2s favored their own payoff salient decision. This, again, yielded a low coordination rate (46–47 percent), but with a pattern of miscoordination exactly the reverse of ASL's.

Second, the patterns of play in AML and ALL differ only slightly. Thus, although ALL's payoff salient decision offers a much higher payoff than AML's ($10 versus $6), ALL's and AML's subjects favor their own payoff salient decisions with approximately equal frequencies.

C. *A Level*-k *Model of Subjects' Decisions in* X-Y *Games*

We now introduce a level-*k* model that gracefully explains subjects' responses across our six *X-Y* treatments, accounting for the patterns of coordination and miscoordination just described. As explained in the introduction, our model has a nonstrategic anchoring type *L0*, which reflects players' instinctive responses to payoff and/or label salience; and two strategic types, *L1* and *L2*, which respectively best respond to *L0* and *L1*. For simplicity, we assume that *L0* has zero frequency, as in most estimates; and we assume that both P1s' and P2s' types are drawn from a common distribution over *L1* and *L2*. Rather than econometrically estimating the frequencies of *L1* and *L2* as in previous work (e.g. Costa-Gomes and Crawford 2006; Crawford and Iriberri 2007a, b), we calibrate them at plausible values that are consistent with estimates from related settings. We also ignore decision errors, which could be added for estimation purposes.

Recall that the anchoring *L0* type represents *L1* players' beliefs about other players' instinctive reactions to salience, *L2*'s beliefs about *L1*'s beliefs, and so on. Bearing in mind that *L0* is only the starting point for players' strategic thinking, we define it via nonstrategic, behaviorally plausible general principles. In symmetric games we assume that *L0* chooses *X* with some probability greater than ½.[9] In any asymmetric game, labeled or unlabeled, and whether or not label salience opposes payoff salience, we assume that *L0* has a "payoff bias," choosing its payoff salient decision with probability $p > ½$, independent of payoffs except as they distinguish SL from labeled asymmetric games. Although *L0*'s choice probabilities are the same for P1s and P2s, they imply *L1* and *L2* choice probabilities that generally differ across player roles due to the asymmetric relations between label and payoff salience for P1s and P2s.[10]

[8] In this respect, the results differ from *Chicago Skyscrapers*, where there was a large drop, from the symmetric to the slightly asymmetric treatment, in the frequency with which subjects in both roles chose *Sears Tower*. As a kind of corollary of this reversal in our *X-Y* treatments, although the frequency with which P1s chose their label salient decisions varied monotonically and intuitively as the games progressed from small to large payoff differences, the frequency with which P2s chose their label salient decisions varied nonmonotonically and sometimes counterintuitively (opposite to the direction suggested by the change in payoffs). This nonmonotonicity suggests that there must be a strategic (though possibly nonequilibrium) component to the explanation.

[9] This probability is not represented by a symbol because its precise magnitude does not influence the model's predictions. Our *L0* is closely related to Mehta et al.'s (1994a, b) and Bardsley et al.'s (2006) notion of primary salience, and our *L1* is related to their notion of secondary salience. However, our analysis makes clear that a probabilistic *L0* is essential to explain the results, and the role-asymmetric relations between label and payoff salience in our games make a clear distinction between *L1* and *L2* (or higher types) essential as well.

[10] Crawford and Iriberri (2007a) argue that maintaining a distinction between people's instinctive, nonstrategic reactions to salience (*L0*) and their strategic thinking (*L1*, *L2*, etc.) gives a level-*k* model important advantages in plausibility and portability. They also argue that if the goal is to explain large asymmetries in behavior across player roles, one should not beg the question by allowing the principles by which *L0* is defined to differ across roles. One could generalize this specification of *L0* by allowing payoff-sensitive choice probabilities or a population distribution of heterogeneous *L0*s, but such generalizations would not yield a clearer explanation of our results.

TABLE 3—L1'S AND L2'S CHOICE PROBABILITIES IN *X-Y* TREATMENTS WHEN $0.505 < p < 0.545$

	Symmetric labeled (SL)	Asymmetric slight labeled (ASL)	Asymmetric moderate labeled (AML)	Asymmetric large labeled (ALL)	Asymmetric slight unlabeled (ASU)	Asymmetric moderate labeled (AMU)
Payoffs for coordinating on "*X*" or its unlabeled analog	\$5, \$5	\$5, \$5.10	\$5, \$6	\$5, \$10	\$5, \$5.10	\$5, \$6
Payoffs for coordinating on "*Y*" or its unlabeled analog	\$5, \$5	\$5.10, \$5	\$6, \$5	\$10, \$5	\$5.10, \$5	\$6, \$5
Pr{X} for P1 *L0*	> ½	$1-p$	$1-p$	$1-p$	$1-p$	$1-p$
Pr{X} for P2 *L0*	> ½	p	p	p	p	p
Pr{X} for P1 *L1*	1	1	0	0	1	0
Pr{X} for P1 *L2*	1	0	1	1	0	1
Pr{X} for P2 *L1*	1	0	1	1	0	1
Pr{X} for P2 *L2*	1	1	0	0	1	0
Total P1 predicted Pr{X}	100%	$100q$%	$100(1-q)$%	$100(1-q)$%	$100q$%	$100(1-q)$%
Total P1 predicted Pr{X}|$q = 0.7$	100%	70%	30%	30%	70%	30%
Total P1 observed Pr{X}	76%	78%	33%	36%	62%	39%
Total P2 predicted Pr{X}	100%	$100(1-q)$%	$100q$%	$100q$%	$100(1-q)$%	$100q$%
Total P2 predicted Pr{X}|$q = 0.7$	100%	30%	70%	70%	30%	70%
Total P2 observed Pr{X}	76%	28%	61%	60%	38%	61%

L1's and *L2*'s choices for P1 and P2 are completely determined by p, the extent of *L0*'s payoff bias. We are unaware of any evidence on this aspect of behavior, so we seek a p that allows the model to track our subjects' responses across the six *X-Y* treatments. The complete reversal of the pattern of miscoordination between ASL on the one hand and AML and ALL on the other guides our search for such a p. The model can track this reversal if and only if 0.505 $(= 5.10/[5.10 + 5]) < p < 0.545 (= 6/[6 + 5])$, so that *L0* has only a modest payoff bias. Assuming that p falls into this range, Table 3 summarizes *L1*'s and *L2*'s choice probabilities across our *X-Y* treatments, with predictions computed for a representative population type distribution with $q = 0.7$, close to most previous estimates of the frequency of *L1*, and with the observed frequencies for comparison. The model's predicted choice frequencies differ from the observed frequencies by more than 10 percent only in LS, where, unsurprisingly, our simplifying assumption that *L0* is the same for all subjects seems to overstate the homogeneity of our subjects. Thus, in this case the model faithfully reproduces the main features of our *X-Y* results.

In SL, with no payoff salience, *L0* favors the salience of *X*. *L1* P1s and P2s therefore both choose *X*, and *L2* P1s and P2s follow suit. Thus, the model makes exactly the same prediction as equilibrium selection based on salience in a Schelling focal point.

The workings of the model can be better understood by considering how it explains why most players choose their partners' payoff salient decisions in ASL and ASU, but their own payoff salient decisions in AML, ALL, and AMU. Continue to assume that $0.505 < p < 0.545$. In ASL, the payoff differences are small enough that *L1* P1s choose *X*, P2s' payoff salient decision, because *L1* P1s think it is sufficiently likely that *L0* P2s will choose *X* that choosing *X* yields them higher expected payoffs. *L2* P2s, who best respond to *L1* P1s, thus choose *X* as well. By contrast, *L1* P2s choose *Y*, P1s' payoff salient decision, because *L1* P2s think it is sufficiently likely that *L0* P1s will choose *Y*. *L2* P1s thus choose *Y* as well. In sum, *L1* P1s choose *X* and *L2* P1s choose *Y*, while *L1* P2s choose *Y* and *L2* P2s choose *X*. When $q = 0.7$, the model predicts that 70 percent of P1s will choose *X* but only 30 percent of P2s will choose *X*, coming close to the observed frequencies of 78 percent and 28 percent and explaining why most subjects choose their partners' payoff salient decision.

In AML, ALL, and AMU, *L0*'s payoffs bias is just as strong (in our simple model) as in ASL and ASU. But because the payoffs bias is not *too* strong ($p < 0.545$), the payoff differences in AML, ALL, and AMU are large enough that *L1* P1s and P2s now both choose their own instead of their partners' payoff salient decisions, *Y* for P1s and *X* for P2s.[11] Because *L2*s best respond to *L1*s in the opposite role, *L2* P1s choose *X* and *L2* P2s choose *Y*. In sum, *L1* P1s choose *Y* and *L2* P1s choose *X*, while *L1* P2s choose *X* and *L2* P2s choose *Y*. When $q = 0.7$, the model predicts that only 30 percent of P1s will choose *X* but 70 percent of P2s will choose *X*, close to the observed frequencies in these treatments and matching the reversed pattern of miscoordination.[12]

Although the model is grounded in players' instinctive reactions to salience, given *L0*'s zero frequency, the model's explanation of our results is driven by those reactions only indirectly, through *L1*'s and *L2*'s strategic responses to *L0*. These responses allow the model to explain the large differences in behavior across player roles as the result of the different relations between label and payoff salience for P1s and P2s, with no difference in behavioral assumptions across roles. These responses also allow the model to explain the superficially counterintuitive reversal of the pattern of miscoordination as the games progressed from small to large payoff asymmetries via *L1*s' best responses to *intuitive* shifts in *L0*s' anticipated choice frequencies. Table 3, however, shows that *L2*s' responses are also an important part of the explanation.

More generally, the model attributes the large swings in subjects' choice frequencies across these treatments to *L1*'s and *L2*'s strong responses to *L0*'s comparatively modest payoffs bias, reflecting players' uncertainty about whether their partners will give priority to label salience when it conflicts with payoff salience, not to any real (that is, non-*L0*) player's strong priority for payoff salience. This strategic "multiplier effect" may have important consequences in other settings.

D. *Related Psychological Findings*

We conclude this section by briefly discussing findings related to our level-*k* explanation in the psychology literature. Part of our argument holds that given payoff symmetry, players easily recognize label salience and its potential as a coordination device, but that in the conflicting presence of payoff salience, they may anticipate that others will respond in ways that interfere with the use of salient labels to coordinate. There is much psychological evidence from other settings that people often systematically overemphasize the impact of material incentives when predicting or explaining others' behavior, as in our model's payoff bias. For instance, Rebecca Ratner and Dale Miller (2001; see also Chip Heath 1999; Heath and Nancy Staudenmeyer 2000) asked participants to donate blood, either voluntarily or for \$15. About equal proportions of participants agreed to donate in either case. However, these same participants, when asked to predict whether others would donate, mistakenly believed that donations would be much more

[11] By contrast, in AML, ALL, and AMU, the fixed-point logic of equilibrium does not unambiguously favor a player's payoff salient decision, recognizing that her/his partner faces similar incentives. There is a large body of experimental evidence that when equilibrium logic differs from the simpler level-*k* logic, subjects' initial responses are better described by the latter; see for example Costa-Gomes and Crawford (2006).

[12] In our asymmetric games (with equal payoffs for both players), any $p > ½$ will yield miscoordination, but the exact pattern will vary with the magnitude of the payoffs bias. For instance, the model predicts the same results for AML and ALL only because the payoffs bias is not *too* strong. If $0.545 (\approx 6/11) < p < 0.667 (\approx 10/15)$, then *L1*'s and *L2*'s choices for P1s and P2s in AML would be the same as those for ASL, rather than for ALL as observed. And if $p > 0.667$, *L1*'s and *L2*'s predicted choices for P1s and P2s in ASL would be the same as those for AML, and the model would not replicate subjects' strikingly different responses in these treatments. Thus, it is likely that estimating a model like ours would yield $0.505 < p < 0.545$, as assumed in Table 3.

likely given a monetary incentive. In Ratner and Miller's setting, making an accurate prediction requires understanding the impact of a greater versus lesser monetary reward. People tended to overestimate the impact of increasing rewards. Analogously, in asymmetric games, it may be that players frequently overestimate the attraction of greater payoffs to one another (though, interestingly, in our *X-Y* games the payoffs bias we inferred that *L1*s believe others (*L0*s) hold was quite modest).

II. *Pie* Games

To further explore the limits of focal points based on salient labels, we next ran experiments with a group of *Pie* games, with different framing and a richer set of relationships between label and payoff salience.

A. *The Games*

Table 4 lists the *Pie* games we studied. Recall that in these games, two players simultaneously select one of three pie slices. The top-left and top-right slices are shaded; the bottom slice is unshaded. Thus, whereas the *Chicago Skyscrapers* and *X-Y* games involved semantic labels such as building names or letters of the alphabet, our *Pie* games explore the effects of visual and geometric labels.

If the players select the same slice they each receive a positive payoff; if they select different slices they receive nothing. We studied eight *Pie* treatments, including three Symmetric treatments, S1–S3; four Asymmetric treatments with Moderate payoff asymmetry, AM1–AM4; and one Asymmetric treatment with Large payoff asymmetry, AL1.

B. *Results and Analysis*

Table 5 presents the results for our *Pie* treatments, which are broadly similar to the results of our *X-Y* treatments, but differ in some interesting ways. As in our *Chicago Skyscrapers* and *X-Y* treatments, payoff asymmetry interfered with subjects' use of salient labels to coordinate. In S1, as expected, the bottom slice, which is visually distinctive in both location and coloring, was strongly label salient, enjoying even greater salience than *Sears Tower* and yielding an even higher coordination rate. Nevertheless, the moderate payoff asymmetry of AM2 yielded miscoordination with high frequency. Interestingly, tweaking the payoffs of AM2, so that the bottom slice is either Pareto-inferior to the others as in AM3 or Pareto-superior as in AM4, does not restore the high coordination rate of S1.

We now consider the extent to which the results of the *Pie* treatments can (and cannot) be explained by a level-*k* model as proposed for our *X-Y* games. A natural specification of *L0* adapts our *X-Y* specification, attributing label salience to *B*; treating the *L* and *R* labels approximately equally, in the absence of payoff differences; and with *L0*'s choice probabilities responding positively to both label and payoff salience but again favoring payoff salience.

In S1, *B* is strongly label salient, there is no payoff salience, and *L1* and therefore *L2* choose B, tracking the results for this treatment. In S2, payoffs are still symmetric, but there is a tension between the label salience of *B* and the equal payoff saliencies of *L* and *R*. A natural extension of our assumptions in *X-Y* and *Chicago Skyscrapers* games has *L0* choosing *L* and *R* with approximately equal probabilities $r/2$, where $r > 0.5$.[13] If $0.5 < r < 0.564$, approximately the

[13] Recall that in asymmetric *X-Y* games, whether or not label salience opposes payoff salience, we assumed that *L0* chooses its payoff salient decision with probability $p > ½$. We again take the probability to be constant, independent of

Table 4—*Pie* Games

		P2		
	P1	L	*R*	*B*
Symmetric 1 ("S1")	*L*	5, 5	0, 0	0, 0
	R	0, 0	5, 5	0, 0
	B	0, 0	0, 0	5, 5
Symmetric 2 ("S2")	*L*	6, 6	0, 0	0, 0
	R	0, 0	6, 6	0, 0
	B	0, 0	0, 0	5, 5
Symmetric 3 ("S3")	*L*	6, 6	0, 0	0, 0
	R	0, 0	5, 5	0, 0
	B	0, 0	0, 0	6, 6
Asymmetric, Large 1 ("AL1")	*L*	5, 10	0, 0	0, 0
	R	0, 0	10, 5	0, 0
	B	0, 0	0, 0	5, 5
Asymmetric, Moderate 1 ("AM1")	*L*	5, 6	0, 0	0, 0
	R	0, 0	6, 5	0, 0
	B	0, 0	0, 0	5, 5
Asymmetric, Moderate 2 ("AM2")	*L*	5, 6	0, 0	0, 0
	R	0, 0	6, 5	0, 0
	B	0, 0	0, 0	6, 5
Asymmetric, Moderate 3 ("AM3")	*L*	5, 6	0, 0	0, 0
	R	0, 0	6, 5	0, 0
	B	0, 0	0, 0	7, 5
Asymmetric, Moderate 4 ("AM4")	*L*	6, 7	0, 0	0, 0
	R	0, 0	7, 6	0, 0
	B	0, 0	0, 0	7, 5

same range as for the p we used to calibrate the model's predictions for *X-Y* games ($0.505 < p < 0.545$), then P1 and P2 *L1*s both choose *B*, because playing *L* or *R* entails a large risk of miscoordination whose cost outweighs the potential benefit of a higher payoff. This choice of *B* tracks subjects' modal responses in both roles, although there is considerable heterogeneity in S2.[14] In S3, in both roles, both *L* and *B* have payoff salience but only *B* has label salience, so an *L0* that favors payoff salience chooses *B* with high probability. P1 and P2 *L1*s then both choose B, again tracking subjects' modal responses in both roles.

In AM1 and AL1, a P1 *L0* favors its uniquely payoff salient *R*, while a P2 *L0* favors *L*. Thus, a P1 *L1* chooses *L* while a P2 *L1* chooses *R*. Higher-order *Lk* types alternate between *L* and *R* in both roles, and so no level-*k* model can explain the strongly modal choice of *B* in each role in these games. Rather, the results for these games appear to be an instance of "team reasoning," as previously observed by Mehta, Starmer, and Sugden (1994a, b) and Bardsley et al. (2006). In these treatments, we speculate, most subjects asked themselves whether there was a rule that would yield a better outcome than individualistic thinking if both P1s and P2s followed it. Because there is no rule that reliably breaks the symmetry between *L* and *R* in these games, playing *L* or *R* entails a large risk of miscoordination, large enough to make playing *B*, which avoids such risk, collectively rational even in AL1, where *L* or *R* yields a player a chance at a payoff of 10. Thus, in this case, label salience remains powerful, even in the face of very large payoff asymmetries.

payoffs, except as they distinguish symmetric from asymmetric games.

[14] Because P1s' and P2s' *L1* responses are in equilibrium, their *L2* responses coincide with *L1* responses, and so do not help to explain the heterogeneity. For this reason, we focus on *L1* responses for these and some other *Pie* games.

TABLE 5—PAYOFFS AND OBSERVED PLAY IN THE EIGHT *PIE* TREATMENTS[a]

	S1	S2	S3	AM1	AL1	AM2	AM3	AM4
L	5,5	6,6	6,6	5,6	5,10	5,6	5,6	6,7
R	5,5	6,6	5,5	6,5	10,5	6,5	6,5	7,6
B	5,5	5,5	6,6	5,5	5,5	6,5	7,5	7,5
N P1				16	14	19	20	15
N P2	17 (pooled)	30 (pooled)	28 (pooled)	15	15	24	21	17
N (%) L P1	1 (6%)	8 (27%)	4 (14%)	1 (6%)	0 (0%)	10 (53%)	8 (40%)	7 (35%)
N (%) L P2				1 (7%)	2 (13%)	5 (21%)	8 (38%)	7 (33%)
N (%) R P1	0 (0%)	9 (30%)	6 (21%)	1 (6%)	1 (7%)	3 (16%)	7 (35%)	8 (40%)
N (%) R P2				0 (0%)	2 (13%)	8 (33%)	6 (29%)	7 (33%)
N (%) B P1	16 (94%)	13 (43%)	18 (64%)	14 (88%)	13 (93%)	6 (32%)	5 (25%)	0 (0%)
N (%) B P2				14 (93%)	11 (73%)	11 (46%)	7 (33%)	3 (14%)
ECoord	89%	35%	48%	82%	69%	31%	34%	25%
EearnP1				4.10	3.50	1.73	1.95	1.63
EearnP2	4.45	5.57	5.73	4.11	3.45	1.64	1.83	1.62

[a] P1s and P2s are theoretically poolable in S1–S3 because subjects could observe no difference in their roles.

In AM2, *R* and *B* both have payoff salience for P1s but only *B* has label salience, so a P1 *L0* favors *B*. *L* is uniquely payoff salient for P2, so a P2 *L0* favors *L*. Thus, a P1 *L1* chooses *L* and a P2 *L1* chooses *B*, tracking subjects' modal responses in both roles. There is great heterogeneity in this treatment, and adding *L2*s to the mix improves the fit (because P1s' and P2s' *L1* responses are not in equilibrium): a P1 *L2* chooses *B* while a P2 *L2* chooses *L*, tracking the second most frequent response for P1s while missing the second most frequent response for P2s.

A team reasoning interpretation of AM2's results is also possible. Here the team rule "*B* for both" is payoff-equivalent to "*R* for both," but *B*, unlike *R*, has label salience. If this eliminates *R* from serious consideration, players are left with a 2 × 2 Battle of the Sexes game in which payoff differences may interfere with the use of the *B* label to break the symmetry between "*L* for both" and "*B* for both." This may explain why subjects chose *L* and *B* with roughly equal frequencies in both player roles. Their choice distributions in fact differ only slightly from those of the symmetric mixed-strategy equilibrium with support on *L* and *B* in these games.

In AM3, *B* has payoff salience for P1s and *L* has payoff salience for P2s, so as in AM2 but for different reasons, a P1 *L0* favors *B* and a P2 *L0* favors *L*. Thus, a P1 *L1* chooses *L* while a P2 *L1* chooses *B*, tracking P1s' modal response in AM3, while missing P2s' modal response in the nearly uniform response distribution this game evoked. As in AM2, P1s' and P2s' *L1* responses are not in equilibrium, and adding *L2*s to the mix improves the fit somewhat.

A team reasoning interpretation of AM3's results is also possible, in this case involving equity or weak Pareto-dominance arguments (rather than payoff-equivalence and label salience as for AM2). In AM3, the team rule "*R* for both" is weakly Pareto-inferior to "*B* for both." If this eliminates *R* from consideration, players are left with a 2 × 2 Battle of the Sexes game in which payoff differences may again interfere with the use of the *B* label to break the symmetry between "*L* for both" and "*B* for both." This may explain why subjects again chose *L* and *B* with roughly equal frequencies. Their choice distributions again differ only slightly from those of the symmetric mixed-strategy equilibrium with support on *L* and *B*.

Finally, in AM4, *R* and *B* have equal payoff salience for P1s and only *L* has payoff salience for P2s, so a P1 *L0* favors the label salient *B* and a P2 *L0* favors *L*. Thus a P1 *L1* chooses *L* while a P2 *L1* chooses *B*, missing the modal response for P1s of *R* and badly missing the modal response for P2s of *B*.

A team reasoning interpretation of AM4's results is again possible, involving equity or weak Pareto-dominance. In AM4, the team rule "*B* for both" is less equitable and weakly Pareto-inferior to "*R* for both." If this eliminates *B* from consideration, players are left with a 2×2 Battle of the Sexes game in which, given that neither *L* nor *R* has strong label salience, there is no way to break the symmetry. This may again explain why subjects again chose *L* and *R* with roughly equal frequencies. Their choice distributions again differ slightly from those of the symmetric mixed-strategy equilibrium on *L* and *R*.

Overall, the results from our *Pie* treatments suggest a more nuanced view of subjects' choices than our *X-Y* results. In the symmetric treatments S1–S3, both level-*k* and team reasoning do a decent job of explaining the results. In asymmetric treatments AM1, AL1, and AM4, no plausible level-*k* model can explain the results, but team reasoning allows plausible partial explanations. In asymmetric treatments AM2 and AM3, the data do not discriminate between the two explanations. However, team reasoning may be the only way to explain the crash in both P1s' and P2s' frequencies of choosing B from AM1 to AM2–AM4.

By contrast, our *X-Y* results are fully compatible with a level-*k* model in all six treatments, and only in the symmetric labeled treatment are they consistent with a team reasoning explanation.[15] It remains puzzling that team reasoning plays an important role in subjects' responses to *Pie* games, but not to *X-Y* games. We speculate that the use of team reasoning depends on Pareto-dominance relations among coordination outcomes and their degree of payoff conflict, but we leave a more systematic investigation of this puzzle to future work.

A synthesis that encompasses both kinds of game might go as follows. Given payoff symmetry, players easily recognize label salience and its potential as a coordination device. But with payoff asymmetry, label salience competes to some extent with payoff salience. Nevertheless, players understand that they should attempt to coordinate. If there is a team rule that does better for both players and they think it sufficiently likely that their partners will follow it, they follow it. Otherwise they fall back on individualistic level-*k* thinking. Although our results and analysis provide some indication of what kinds of setting favor level-*k* thinking and what kinds favor team reasoning, we leave a full answer to this question for future work.

III. Conclusion

Since Schelling, it has often been assumed that players in asymmetric as well as symmetric games can use the salience of available labels to improve coordination. The experiments reported here confirm, in two quite different sets of games, that when payoffs are symmetric across players, salient labels do yield high coordination rates, but that when payoffs are even minutely asymmetric and the salience of labels conflicts with the salience of payoff differences, salient labels may lose much of their effectiveness and coordination rates may be very low.

Our primary goal has been simply to report this stylized fact, but our analysis elucidates common elements of strategic thinking and helps to discriminate between two complementary explanations of our results, based on "level-*k* thinking" and "team reasoning." We believe that a judicious combination of these explanations, possibly incorporating other considerations, should help to predict the effectiveness of focal points based on label salience in other settings.

[15] This claim is obvious for the asymmetric labeled treatments, where players could have "freely disposed" of the payoff asymmetry and coordinated on *X*, but didn't. In the asymmetric unlabeled treatments, the best team rule (depending on whether one imposes equilibrium) is either the mixed-strategy equilibrium or 50-50 randomization, which both yield expected coordination rates far higher than subjects achieved in these treatments.

REFERENCES

Bacharach, Michael. 1993. "Variable Universe Games." In *Frontiers of Game Theory*, ed. Kenneth Binmore, Alan Kirman, and Piero Tani, 255–75. Cambridge, MA: MIT Press.

Bacharach, Michael, and Michele Bernasconi. 1997. "The Variable Frame Theory of Focal Points: An Experimental Study." *Games and Economic Behavior*, 19(1): 1–45.

Bacharach, Michael, and Dale O. Stahl. 2000. "Variable-Frame Level-*n* Theory." *Games and Economic Behavior*, 32(2): 220–46.

Bardsley, Nicholas, Judith Mehta, Chris Starmer, and Robert Sugden. 2006. "The Nature of Salience Revisited: Cognitive Hierarchy Theory versus Team Reasoning." Unpublished.

Blume, Andreas. 2000. "Coordination and Learning with a Partial Language." *Journal of Economic Theory*, 95(1): 1–36.

Blume, Andreas, and Uri Gneezy. 2000. "An Experimental Investigation of Optimal Learning in Coordination Games." *Journal of Economic Theory*, 90(1): 161–72.

Blume, Andreas, and Uri Gneezy. 2002. "Cognitive Forward Induction and Coordination without Common Knowledge: Theory and Evidence." Unpublished.

Brandts, Jordi, and Charles Holt. 1993. "Dominance and Forward Induction: Experimental Evidence." In *Research in Experimental Economics*, Vol. 5, ed. R. Mark Isaac, 119–36. Greenwich, CT: JAI Press.

Brandts, Jordi, and W. Bentley MacLeod. 1995. "Equilibrium Selection in Experimental Games with Recommended Play." *Games and Economic Behavior*, 11(1): 36–63.

Cachon, Gerard P., and Colin F. Camerer. 1996. "Loss-Avoidance and Forward Induction in Experimental Coordination Games." *Quarterly Journal of Economics*, 111(1): 165–94.

Camerer, Colin F. 2003. *Behavioral Game Theory: Experiments in Strategic Interaction*. Princeton: Princeton University Press.

Camerer, Colin F., and Teck-Hua Ho. 1998. "Experience-weighted Attraction Learning in Coordination Games: Probability Rules, Heterogeneity, and Time Variation." *Journal of Mathematical Psychology,* 42(2–3): 305–26.

Camerer, Colin F., Teck-Hua Ho, and Juin-Kuan Chong. 2004. "A Cognitive Hierarchy Model of Games." *Quarterly Journal of Economics*, 119(3): 861–98.

Cooper, Russell W., Douglas V. DeJong, Robert Forsythe, and Thomas W. Ross. 1989. "Communication in the Battle of the Sexes Game: Some Experimental Results." *RAND Journal of Economics*, 20(4): 568–87.

Cooper, Russell W., Douglas V. DeJong, Robert Forsythe, and Thomas W. Ross. 1990. "Selection Criteria in Coordination Games: Some Experimental Results." *American Economic Review*, 80(1): 218–33.

Cooper, Russell W., Douglas V. DeJong, Robert Forsythe, and Thomas W. Ross. 1992a. "Communication in Coordination Games." *Quarterly Journal of Economics*, 107(2): 739–71.

Cooper, Russell W., Douglas V. DeJong, Robert Forsythe, and Thomas W. Ross. 1992b. "Forward Induction in Coordination Games." *Economics Letters*, 40(2): 167–72.

Cooper, Russell W., Douglas V. DeJong, Robert Forsythe, and Thomas W. Ross. 1993. "Forward Induction in the Battle-of-the-Sexes Games." *American Economic Review*, 83(5): 1303–16.

Costa-Gomes, Miguel A., Vincent P. Crawford, and Bruno Broseta. 2001. "Cognition and Behavior in Normal-Form Games: An Experimental Study." *Econometrica*, 69(5): 1193–1235.

Costa-Gomes, Miguel A., and Vincent P. Crawford. 2006. "Cognition and Behavior in Two-Person Guessing Games: An Experimental Study." *American Economic Review*, 96(5): 1737–68.

Crawford, Vincent P. 1995. "Adaptive Dynamics in Coordination Games." *Econometrica*, 63(1): 103–43.

Crawford, Vincent P. 1997. "Theory and Experiment in the Analysis of Strategic Interaction." In *Advances in Economics and Econometrics: Theory and Applications, Seventh World Congress*, Vol. 1, ed. David Kreps and Ken Wallis, 206–42. Cambridge: Cambridge University Press.

Crawford, Vincent P. 1998. "A Survey of Experiments on Communication Via Cheap Talk." *Journal of Economic Theory*, 78(2): 286–98.

Crawford, Vincent P., and Bruno Broseta. 1998. "What Price Coordination? The Efficiency-Enhancing Effect of Auctioning the Right to Play." *American Economic Review*, 88(1): 198–225.

Crawford, Vincent P., and Hans Haller. 1990. "Learning How to Cooperate: Optimal Play in Repeated Coordination Games." *Econometrica*, 58(3): 571–95.

Crawford, Vincent P., and Nagore Iriberri. 2007a. "Fatal Attraction: Salience, Naivete, and Sophistication in Experimental 'Hide-and-Seek' Games." *American Economic Review*, 97(5): 1731–50.

Crawford, Vincent P., and Nagore Iriberri. 2007b. "Level-*k* Auctions: Can a Nonequilibrium Model of Strategic Thinking Explain the Winner's Curse and Overbidding in Private-Value Auctions?" *Econometrica*, 75(6): 1721–70.

Gneezy, Uri. 2005. “Step-Level Reasoning and Bidding in Auctions.” *Management Science*, 51(11): 1633–42.

Gneezy, Uri, and Yuval Rottenstreich. 2005. “The Power of Focal Points is Limited: Even Minute Payoff Asymmetry Yields Massive Coordination Failures.” Unpublished.

Harsanyi, John C., and Reinhard Selten. 1988. *A General Theory of Equilibrium Selection in Games*. Cambridge, MA: MIT Press.

Haruvy, Ernan, and Dale O. Stahl, II. 2004. “Deductive versus Inductive Equilibrium Selection: Experimental Results.” *Journal of Economic Behavior and Organization*, 53(3): 319–31.

Heath, Chip. 1999. “On the Social Psychology of Agency Relationships: Lay Theories of Motivation Overemphasize Extrinsic Incentives.” *Organizational Behavior and Human Decision Processes*, 78(1): 25–62.

Heath, Chip, and Nancy Staudenmeyer. 2000. “Coordination Neglect: How Lay Theories of Organizing Complicate Coordination in Organizations.” In *Research in Organizational Behavior*, Vol. 22, ed. Barry Staw and Nancy Staudenmayer, 153–91. Greenwich, CT: JAI Press.

Ho, Teck-Hua, Colin Camerer, and Keith Weigelt. 1998. “Iterated Dominance and Iterated Best Response in Experimental ‘*p*-Beauty Contests.’ ” *American Economic Review*, 88(4): 947–69.

Mehta, Judith, Chris Starmer, and Robert Sugden. 1994a. “Focal Points in Pure Coordination Games: An Experimental Investigation.” *Theory and Decision*, 36(2): 163–85.

Mehta, Judith, Chris Starmer, and Robert Sugden. 1994b. “The Nature of Salience: An Experimental Investigation of Pure Coordination Games.” *American Economic Review*, 84(3): 658–73.

Nagel, Rosemarie. 1995. “Unraveling in Guessing Games: An Experimental Study.” *American Economic Review*, 85(5): 1313–26.

O’Neill, Barry. 1987. “Nonmetric Test of the Minimax Theory of Two-Person Zerosum Games.” *Proceedings of the National Academy of Sciences of the United States of America*, 84(7): 2106–09.

Rapoport, Amnon, and Richard B. Boebel. 1992. “Mixed Strategies in Strictly Competitive Games: A Further Test of the Minimax Hypothesis.” *Games and Economic Behavior*, 4(2): 261-83.

Ratner, Rebecca, and Dale Miller. 2001. “The Norm of Self-Interest and Its Effects on Social Action.” *Journal of Personality and Social Psychology*, 81(1): 5–16.

Rubinstein, Ariel. 1999. “Experience from a Course in Game Theory: Pre- and Post-Class Problem Sets as a Didactic Device.” *Games and Economic Behavior*, 28(1): 155–70.

Rubinstein, Ariel, and Amos Tversky. 1993. “Naïve Strategies in Zero-Sum Games.” Tel Aviv University Sackler Institute of Economic Studies Working Paper 17–93.

Rubinstein, Ariel, Amos Tversky, and Dana Heller. 1996. “Naive Strategies in Competitive Games.” In *Understanding Strategic Interaction-Essays in Honor of Reinhard Selten*, ed. Wulf Albers, Werner Güth, Peter Hammerstein, Bemmy Moldovanu, and Eric van Damme, 394–402. Berlin: Springer-Verlag.

Schelling, Thomas. 1960. *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.

Stahl, Dale O., II, and Paul W. Wilson. 1994. “Experimental Evidence on Players’ Models of Other Players.” *Journal of Economic Behavior and Organization*, 25(3): 309–27.

Stahl, Dale O., II, and Paul W. Wilson. 1995. “On Players’ Models of Other Players: Theory and Experimental Evidence.” *Games and Economic Behavior*, 10(1): 218–54.

Straub, Paul G. 1995. “Risk Dominance and Coordination Failures in Static Games.” *Quarterly Review of Economics and Finance*, 35(4): 339–63.

Sugden, Robert. 1995. “A Theory of Focal Points.” *Economic Journal*, 105(430): 533–50.

Van Huyck, John B., Raymond C. Battalio, and Richard O. Beil. 1990. “Tacit Coordination Games, Strategic Uncertainty, and Coordination Failure.” *American Economic Review*, 80(1): 234–48.

Van Huyck, John B., Raymond C. Battalio, and Richard O. Beil. 1991. “Strategic Uncertainty, Equilibrium Selection, and Coordination Failure in Average Opinion Games.” *Quarterly Journal of Economics*, 106(3): 885–910.

Van Huyck, John B., Raymond C. Battalio, and Richard O. Beil. 1993. “Asset Markets as an Equilibrium Selection Mechanism: Coordination Failure, Game Form Auctions, and Tacit Communication.” *Games and Economic Behavior*, 5(3): 485–504.

Van Huyck, John B., Raymond C. Battalio, and Frederick W. Rankin. 1997. “On the Origin of Convention: Evidence from Coordination Games.” *Economic Journal*, 107(442): 576–96.

Van Huyck, John B., Joseph P. Cook, and Raymond C. Battalio. 1997. “Adaptive Behavior and Coordination Failure.” *Journal of Economic Behavior and Organization*, 32(4): 483–503.

Van Huyck, John B., Ann B. Gillette, and Raymond C. Battalio. 1992. “Credible Assignments in Coordination Games.” *Games and Economic Behavior*, 4(4): 606–26.