The Impact of Meaningful Context on Strategic Play in Signaling Games[1]

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Abstract

Psychologists have provided abundant evidence that behavior can differ in fundamental ways when problems are embedded in a meaningful, as opposed to abstract, context. Our paper explores the effects of meaningful context on behavior in a signaling game experiment. Meaningful context significantly increases the initial level of strategic play. This effect fades over time, so that meaningful context partially substitutes for experience. There is also evidence that meaningful context can fundamentally affect subjects' reasoning processes. These results suggest that meaningful context might better capture behavior in field settings and improve the performance of equilibrium refinements for certain games.

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One of the important methodological differences in experiments conducted by economists and psychologists is the economist's preference for studying behavior in generic (or abstract) settings as opposed to the psychologist's preference for embedding behavior in a naturalistic setting. For example, economists in studying Bayes' rule typically operationalize the relevant probabilities using a "balls and bingo cage" design. In contrast, psychologists typically embed the relevant probabilities in a vignette, like the taxi cab problem.[2] Economists prefer abstract settings for a variety of reasons. Perhaps foremost among these is the belief that it is only the deep, underlying mathematical structure of the problem that matters (or should matter) for behavior. Additional reasons are that meaningful context may obscure the underlying economic structure of the problem and that meaningful context may generate responses that are inappropriate for the question at hand (e.g. Cohen, Levine, and Plott, 1978).

Yet there are important reasons to study behavior in natural settings since there is abundant evidence that subjects' reasoning processes can be affected in fundamental ways when problems are embedded in meaningful, as opposed to abstract or generic, context. An important example of these differences from the psychology literature is the "four card selection problem" introduced by Wason (1966). In a typical generic version of this problem subjects are shown four cards lying on a table top. They are told that each card has either an A or a K on one side and either a 4 or a 7 on the other. The four cards are arranged so that each of the four possibilities (A,K,4, or 7) is facing up on one card. Subjects are then asked to select two cards to determine whether the statement "all cards with an A on one side must have a 4 on the other side" is true or false. A "rational" subject should always select the cards showing an A and a 7 – the other two cards are useless in verifying the truth of the statement. In fact, only about 10% of subjects select the correct cards in this generic version of the four card problem.[3]

[2] For example, compare Grether (1980) with Kahneman and Tversky (1972). See Camerer (1995) for further discussion of this and other methodological differences between economists and psychologists.

[3] The most frequent error is selection of the card with a 4 rather than the card with 7.

In contrast, meaningful context can have a dramatic impact on the frequency with which subjects are able to correctly solve this problem. In one famous example, researchers restated the problem in terms of legal drinking age – each card had a beverage (beer or soda) on one side and an age (16 or 22) on the other. Subjects were asked to verify that any individual who was sixteen was drinking soda rather than beer. The proportion of correct responses with this framework was about 70% (Chrostowski and Griggs, 1985). Analogous results have been found in psychological studies of other mental processes (memory, learning, categorizing, deductive reasoning, problem solving, and cognitive development).[4]

The present paper explores the potential effects of meaningful context in a signalling game experiment. It has long been known that signalling games often yield a bewildering profusion of sequential equilibria. This has led theorists to devise numerous refinements for limiting the set of sequential equilibria (Grossman and Perry, 1986, Cho and Kreps, 1987, Banks and Sobel, 1987, and Mailath, Okuno-Fujiwara, and Postlewaite,1993). All of these refinements rely on the concept of forward induction. Not only are players expected to use sophisticated reasoning in interpreting messages, but they are also supposed to anticipate the reasoning which will be used by other players in interpreting messages.

Early experimental work on signalling games purported to show that behavior was consistent with a number of these induction based refinements (see Banks, Camerer, and Porter, 1994). However, later experiments have demonstrated that subjects tend to follow simple, history dependent learning processes and, with the right game structure, can be induced into violating even the simplest of equilibrium refinements (Brandts and Holt, 1992, 1993, Cooper, Garvin and Kagel, 1997a, b). It is noteworthy that all of these experiments were conducted using generic contexts. Given the psychology results on reasoning and context, this lack of a meaningful context may partially explain why subjects seem to make such limited use of the forward induction arguments inherent in the refinements literature. Put simply, generic

[4]See Dominowski (1995) for a survey of the literature on context effects in Wason's four card selection problem. See Goldstein and Weber (1995) for a survey of context effects on assorted cognitive processes.

context may rob subjects of any intuitive basis for applying these forward induction arguments. The work here explores this possibility and its implications for experimental economics as a whole.

Our signalling game experiment is based on Milgrom and Roberts' (1982) entry limit pricing model. In this game, a potential entrant faces an incumbent monopolist with either high or low costs. Critically, the entrant only wishes to enter the industry if it believes the monopolist has high costs. While the entrant cannot directly observe the monopolist's costs, it does observe an output decision by the monopolist before choosing whether or not to enter the industry. This gives the monopolist an incentive to strategically manipulate its output in order to change the entrants' beliefs about its true costs.[5] We refer to such strategic behavior as "limit pricing."

The limit pricing model provides a natural context for the game, not a context we expect students to have direct experience with, but one which we believe can provide a meaningful framework for thinking about the problem. Sessions are divided between treatments which employ a generic context and treatments in which the context is meaningful. The generic context uses abstract terms throughout. For example, monopolists are referred to as "A players"and potential entrants are described as "B players." Other terms are given similarly meaningless labels. The meaningful context uses natural terms while avoiding any value laden language. Thus, the monopolist is referred to as the "existing firm" and the potential entrant becomes the "other firm" deciding between entering "this" market or some "other" market.

We postulate two possible effects of meaningful context. On a low level, we hypothesize that meaningful context may serve as a catalyst, speeding up the learning and adjustment process but not necessarily changing the underlying reasoning process. These are "weak context effects," since neither the main features of the adjustment process nor the equilibrium outcome play converges to are affected

[5]A high cost monopolist may wish to increase its output in order to mimic a low cost type. A low cost monopolist may wish to increase its output in order to separate itself from high cost types.

by the use of meaningful context. We also hypothesize that there may exist "strong context effects," where meaningful context not only speeds up the learning and adjustment process, but also impacts on subjects' underlying reasoning processes. The latter may alter the equilibrium adjustment process and/or the equilibrium outcome that play converges to. We examine data from several versions of the limit pricing game for both weak and strong context effects.

Our results can be summarized as follows: Although meaningful context does not affect the overall pattern of play observed in the data, there is strong support for the existence of weak context effects. In particular, the presence of meaningful context substantially increases the frequency of limit pricing by high cost monopolists in early rounds. This effect fades over time, so that meaningful context acts as a partial substitute for experience. Meaningful context only modestly increases the overall frequency of strategic play for low cost monopolists. However, significantly more subjects attempt to limit price at least once as low cost monopolists in sessions with meaningful context. We argue that this may reflect a strong context effect. The data also suggest that meaningful context can affect the equilibrium outcome in signalling games. One of our treatments is designed to retard the development of limit pricing by making it difficult for potential entrants to recognize the existence of dominated strategies for high cost monopolists. With generic context, the amount of limit pricing by low cost monopolists is less in this treatment (than in our standard treatment) and limit pricing typically does not occur at the efficient separating equilibrium (the intuitive outcome). If strong context effects exist, we might expect to see one or both of these effects eliminated with meaningful context. Although meaningful context does not eliminate the decline of limit pricing in this treatment, outcomes are somewhat more consistent with the intuitive outcome. This last result is not strong enough to be statistically significant, but it suggests that strong context effects may emerge in related games.

Overall, our results have several implications for the experimental study of game theory, and for experimental economics in general. The use of meaningful context can matter. Specifically, meaningful context can speed up the natural learning processes of subjects. Assuming that the context is carefully designed to avoid demand induced effects, experimenters should be able to achieve cleaner convergence and obtain sharper results with the use of meaningful context. Further, in some signalling games the use of meaningful context may even change the equilibrium that play converges to. On the other hand, our data provides no evidence that meaningful context can alter subjects' reasoning processes sufficiently to be able to establish the sophisticated, forward thinking behavior that the equilibrium refinements literature is based on. Rather, behavior will continue to be best characterized by adaptive learning models with boundedly rational agents.

II. The Limit Pricing Game

A. Experimental Design: The payoffs and signals employed are based on Milgrom and Roberts' (1982) model of limit entry pricing. Milgrom and Roberts describe a two period game with a homogeneous good and a linear market demand curve. The game is played between a monopolist (M) and a potential entrant (E). There are two possible monopolist types, high and low cost (MH and ML). The M's cost level is realized according to predetermined probabilities that are common knowledge. The game begins with M observing its type. In the first period of the game, M chooses a price absent any rival producers. E sees this price, but not M's type, and either enters or stays out in the second period. It is assumed that if entry occurs the two firms behave as Cournot duopolists in the second period. If entry does not occur, M produces its profit maximizing, uncontested monopoly quantity in the second period. The asymmetric information, in conjunction with the fact that it is profitable to enter against MHs, but not against MLs, provides an incentive for limit-pricing in the first period.

In our experiment we simplify the game even further, collapsing the two-stage game into a single stage by imposing the second stage outcomes and providing Ms with a payoff table representing the net profit from both stages. This change allows us to focus on the signalling aspects of the game, and has the added benefit of speeding up play in the experiment.

The "standard quantity" version of Ms' payoffs are given in Table 1a. Payoffs to Ms include the profit for their first stage decision added to the present discounted value of the profit in the second stage, where we impose the Cournot outcome following entry (IN) or the uncontested monopoly outcome following not entering (OUT) in the second stage. Ms' choices, 1-7, may be thought of as output levels, with higher output corresponding to lower prices.[6] The prior probabilities of the two M types are 50% throughout..

Three features of the standard quantity game capture the main strategic elements confronting Ms. First, all else being equal, Ms are always better off if Es choose OUT rather than IN. It follows that Ms can gain by deterring entry. Second, reflecting their lower marginal costs, MLs generally prefer higher output (lower prices) than MHs. This can be seen in Ms' actions should they ignore the effect of their choices on E's behavior -- MLs would choose an output of 4 as opposed to 2 for MHs. These choices will be referred to as the Ms' "non-strategic" maxima. Finally, output choices 6 and 7 are dominated strategies for MHs, but not for MLs. At these outputs MLs can perfectly distinguish themselves from MHs so that pure strategy separating equilibria exist.

[Insert Table 1 here]

E's payoff table reflects the second period returns for staying out or entering and playing a Cournot duopoly game. Two different payoff tables, Tables 1b and 1c, are used for Es in the standard quantity game. These represent high cost (EH) and low cost (EL) entrants respectively. Only one of these two tables is in effect at any given time. In both tables it always pays to play IN when M is known to be an MH type and to play OUT against an ML type. However, given the prior probability of the different M types, the expected value of OUT is greater than IN in Table 1b (250 vs. 187) and the

[6]Payoffs are given in the experimental currency francs. Francs were converted to dollars at the end of the experiment, with one franc equal to $.001.

expected value of IN is greater than OUT in Table 1c (350 vs. 250).

In some sessions Ms' choices were characterized in terms of prices rather than quantities. Payoffs in the standard price game are a linear transformation of payoffs in the standard quantity game, leaving equilibrium predictions unaffected. Statistical analysis finds no significant differences between play in the price and quantity games, other things equal. As such we do not distinguish between the two treatments, referring to both as the "standard game," with all discussion framed in terms of the quantity game.

A more substantial variation in the standard quantity game involved changing MHs' payoffs for output levels 6 and 7 from negative to positive numbers, as shown in italics on Table 1a. All sessions with this altered payoff table used ELs (Table 1c). Even with this change, play of 6 or 7 is still a dominated strategy for MHs, and equilibrium predictions are unaffected. Rather, this change in payoffs is designed to make the detection of dominated strategies more difficult for subjects. Following Cooper *et al* (1997a), we refer to this as the "zero anticipation" treatment.

B. *Equilibrium Predictions:* For the standard game with EHs, there exist multiple pure strategy pooling, as well as separating, equilibria.[7] Pure strategy pooling equilibria occur at output levels 1-5. For example, consider a pooling equilibrium at output 3. Given the prior probabilities over M's type, E's expected value of OUT is greater than IN so that pooling deters entry. Out-of-equilibrium beliefs (OEBs) which support this equilibrium are that any deviation involves an MH type with sufficiently high probability to induce entry. Given these OEBs both MHs and MLs achieve higher profits at 3 rather than deviating to their non-strategic maxima. Similar OEBs support the other pooling equilibria: any deviation from the proposed equilibrium represents an MH type with sufficiently high probability to induce entry. Pooling equilibria at output levels 3-5 involve strategic behavior (limit-pricing) as MHs produce a larger quantity (and charge a

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[7]All of the equilibria to be described are sequential (Kreps and Wilson, 1982).

lower price) than would occur under full information.

Two pure strategy separating equilibria exist for the standard game with EHs . In both of these MHs always choose 2 and are always entered on; MLs either always choose 6 or always choose 7 and never incur entry. With MLs choosing 6 or 7, it does not pay for MHs to imitate them as they earn greater profits by choosing their non-strategic maxima (choice of 2 dominates 6 and 7 for MHs). Once again the OEBs supporting these equilibria are that any deviation from the proposed equilibrium involves an MH type with sufficiently high probability to induce entry, as this deters MLs from choosing lower output levels. These separating equilibria involve strategic behavior (limit pricing) by MLs as they produce a larger quantity (and charge a lower price) than under full information conditions.

In the standard payoff treatment with ELs no pure strategy pooling equilibria exist. With both Ms choosing the same output level, the expected value of IN is greater than OUT in Table 1c. This destroys any pure strategy pooling equilibrium. The two pure strategy separating equilibria still exist with ELs. The standard game with ELs also has several partial pooling (mixed strategy) equilibria. One of these is especially noteworthy, as it arises in a significant number of simulations. In this equilibrium, MLs always select 5 while MHs mix between 2 (probability .80) and 5 (probability .20). Es always enter on output levels other than 5, and enter on 5 with probability .11. Finally, the equilibrium set for the zero anticipation treatment is identical to that for the standard game with ELs.

As is typical of signalling games, the limit pricing game suffers from an overabundance of equilibria. To obtain sharper predictions, we apply the most common of the equilibrium refinements for signalling games, the intuitive criterion of Cho and Kreps. This reduces the equilibrium set for the standard game with EHs to pooling at 4 or 5, or separating with MLs choosing 6. All three of these outcomes involve limit pricing by one type. With ELs, only the separating equilibrium in which MLs choose 6 satisfies the intuitive criterion.

Previous experiments (Brandts and Holt, 1992 and 1993, and Cooper, Garvin, and Kagel, 1997a) find that equilibrium refinements do a poor job of predicting subjects' behavior in signalling games. As an alternative, Cooper, Garvin, and Kagel (1997b) propose a simple adaptive learning model which captures the major features in the evolution of subjects' behavior. This learning model is closely related to fictitious play, modified to allow for play versus a population and Es having some ability to recognize dominated strategies. For the standard game with EHs, the model predicts that Ms' choices will initially cluster at their non-strategic maxima (2 for MHs and 4 for MLs). In response, the entry rate for 2 will rise while the entry rate for 4 falls. This increase in the entry rate differential induces MHs to limit price by switching to play of 4. In the long run, play converges to the pooling equilibrium at 4. The early stages of play in simulations of the learning model are identical with ELs – initial play of the non-strategic maxima leads to a rise in entry rate differentials which in turn induces MHs to attempt pooling at 4. However, pooling at 4 is not an equilibrium in games with ELs, which leads to an increase in the entry rate on 4, thereby promoting limit pricing by MLs. The exact nature of limit pricing depends on the ability of Es to recognize the existence of dominated strategies. If most Es recognize that play of 6 or 7 must come from MLs, the entry rate on these strategies will be very low. These low entry rates encourage MLs to limit price by choosing 6. Eventually, play converges to the intuitive outcome (the efficient separating equilibrium with MLs playing 6). On the other hand, if Es have difficulty recognizing the dominated strategies, as we would expect with the zero anticipation treatment, entry rates on 6 and 7 will be relatively high. This has two effects: (1) the emergence of limit pricing by MLs is slowed down relative to the standard treatments and (2) limit pricing occurs primarily at output level 5 rather than 6. Confirmation of these two predictions have been reported in Cooper *et al* (1997a) within a generic context.

III. Experimental Procedures

Each experimental session employed between 12 and 16 subjects who were randomly assigned to computer terminals. A common set of instructions were read out loud, with each subject having a written copy. Subjects had copies of both Ms' and Es' payoff tables and were required to fill out short questionnaires to insure their ability to read them. After reading the instructions, questions were answered out loud and play began with a single practice round followed by more questions.

Before each play of the game the computer randomly determined each M's type. After seeing their types, Ms chose a number between 1 and 7. Each M's choice was sent to the E they were paired with for that play of the game, after which the Es decided between IN and OUT. Following each play of the game subjects learned the outcome of their own choices and the type of M player they were paired with (but not the other player's identity). In addition, the lower left-hand portion of each subject's screen displayed the results of all pairings (Ms' choices, Es' responses, and Ms' type) with subject identification numbers suppressed. The format in which this information was presented is a treatment variable which is discussed below. Subjects switched roles after every 6 games, with M players becoming E players and vice versa. Within each set of 6 games each M was paired with a different E in each round. Sessions typically had 36 games with the number of games announced in advance.[8]

Subjects were recruited through announcements in undergraduate classes and posters placed throughout the University of Pittsburgh and Carnegie Mellon University. The posters resulted in recruiting a broad cross section of undergraduate and graduate students from both campuses. Sessions lasted a little under two hours. Subjects were paid $5 for showing up on time. Earnings averaged $17.50 per subject.

Table 2 summarizes the experimental treatments. The treatment variables of primary interest are what type of instructions were used (generic vs. meaningful context) and how feedback was presented to subjects after each round (black and white and unsorted or color coded and sorted by output level).[9]

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[8]One session had only 24 games since it was conducted in an undergraduate economics class during class time, which limited the number of games. We believe that switching roles within a session speeds up learning, although we have never tested this formally.

[9]Results from a number of the generic sessions have been reported previously in Cooper *et al* (1997a, b).

[Insert Table 2 here]

In generic context (GC) sessions, neutral terms were used throughout. For example, Ms were called “A players” (type A1 for MH, type A2 for ML) and Es were called “B players.” The instructions provided subjects with no guidance as to what sort of situation was being modeled. In meaningful context (MC) sessions the language used was more natural, with Ms referred to as “existing firms” and Es referred to as “other firms” who were deciding between entry into “this industry or some other industry.” The two M types were specifically described as being “high cost” and “low cost.” We were careful to avoid pejorative terms which could elicit strong meaning responses – for example, we did not refer to Ms are “monopolists”and purposely characterized Es choices as a decision to enter one industry or another rather than simply choosing between in and out. The instructions provided the subjects with a concrete setting for the game, competition between an existing firm and a potential entrant. While we would be extremely surprised if any of our subjects had direct experience with this context, it should provide a meaningful framework for organizing their thoughts about the structure of the game.

We intentionally avoided the use of a context which subjects would be likely to have direct experience with. One possible role of meaningful context is to facilitate transfer of experience from other, related games (see Cooper, Kagel, Lo, and Gu, 1999). We wanted to eliminate this possibility, focusing on how meaningful context impacts the reasoning processes of subjects facing a game for the first time.

In designing these treatments our original goal was to see if we could somehow speed up the emergence of limit pricing. As such, in addition to adding meaningful context we also changed the way information was presented to subjects at the end of each round. Recall that at the end of each round subjects are shown the outcomes for all pairings. In the original generic sessions, the pairings are presented in a random order in a black and white format. Results reported by Miller and Plott (1985) suggested that performance of the intuitive criterion could be improved by presenting the data in a more structured fashion. We therefore altered the presentation format for the MC sessions. Pairings with MH types were highlighted in red, while pairings with ML types were highlighted in green, with the feedback ordered by output levels. These changes were intended to make it easier to identify, for example, that MHs were generally associated with low output levels. To distinguish which of our changes - meaningful context or information feedback - were responsible for the changes in behavior observed, we ran several generic sessions with color coded and sorted feedback. All sessions in this control treatment employed standard games with ELs. In what follows these will be referred to as the "feedback" sessions.

IV. Experimental Results

A. An Overview of the Data: Figures 1-6 depict the development of play over time for each of the major treatments. Play is pooled into twelve period cycles (periods 1 - 12 for cycle 1, periods 13 - 24 for cycle 2, and periods 25 - 36 for cycle 3).[10] The figures show the percentage of play for each M type for each strategy, with entry rates listed below the strategy. Data is pooled across sessions of the same treatment. Data for the feedback sessions will be discussed separately.

[Insert Figures 1-6 here]

The general pattern of play is the same across all treatments regardless of context: In standard games with *both* EHs and ELs, Ms' play is initially concentrated around their respective non-strategic maxima. From the very beginning this leads to much higher entry rates for outputs of 3 or less than for higher outputs. Responding to this entry rate differential, MHs start to mimic ML's, so that by the third cycle, 4 has become the modal outcome for MHs for *all* treatments.

Comparing EL sessions with EH sessions, entry rates are substantially higher at all output levels

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[10]Within each cycle subjects have played 6 times as Es and 6 times as Ms. In reporting data by cycles we conceal changes over time within a cycle for the sake of averaging over the population holding levels of experience approximately equal. A more fine grained analysis would confound changes over time within a cycle with changes resulting from different individuals playing different roles. The statistical analysis that follows uses individual subject data.

and are increasing over time for output level 4, rather than decreasing. As a result, in later cycles of play it becomes attractive for MLs to separate to higher outputs. (An entry rate differential of 13% is required to make moving from 4 to 6 optimal for MLs. By the third cycle, this differential is over 20%, on average, in standard games with ELs.[11]) While 4 remains the modal outcome for MLs in the third cycle of standard games with ELs, around 30% of ML play involves limit pricing (output levels 5, 6 or 7).

Recall that the zero anticipation payoff tables are designed to make it more difficult for Es to recognize that 6 and 7 are dominated strategies for MHs. This treatment is expected to yield lower levels of limit pricing than observed in the standard treatment, and to shift limit pricing towards 5 rather than 6 or 7. These predictions are borne out by the data. Only 13% of MLs' play in the third cycle involves limit pricing (12% in GC sessions and 15% in MC sessions), less than half the rate observed under the standard treatment. Moreover, the probability of playing 5 conditional on limit pricing in the third cycle is higher in the zero anticipation treatment (61%) than in the standard treatment (46%), with this difference coming entirely from the GC sessions..

The figures show that meaningful context has no impact on the general pattern of play. Ms' initial choices are concentrated at their respective non-strategic maxima both with and without MC. In both cases limit pricing only gradually emerges, largely in response to Es behavior. The overall pattern of play in both treatments is consistent with the Cooper et al. learning model (as well as other learning models). This is not to say that the MC treatment has no effect on behavior. To the contrary it does, most importantly in speeding up the development of MHs' limit pricing and, to a lesser extent, facilitating the development of MLs' limit pricing as well. In what follows we document these effects.

B. Games with High Cost Entrants: Table 3 summarizes choice data from standard games with EHs. The top half of this table reports the proportion of strategic play by type. For both types of M, strategic

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[11]In contrast, the average entry rate differential in games with EHs does not support MLs' limit pricing in the third cycle of play.

play is defined as choice of an output level greater than their non-strategic maxima (output of 3 or greater for MHs and 5 or greater for MLs). The bottom half of the table gives entry rates at various output levels.

[Insert Table 3 here]

From the aggregate data in Table 3, we observe that both M types play more strategically in MC sessions than in GC sessions. For MHs, this effect is strongest in the first cycle of play (29% strategic play with GC vs. 47% with MC), and fades over time. For MLs the effect grows over time, peaking in the third cycle (7% strategic play with GC vs. 19% with MC). Thus, the data in Table 3 suggest that meaningful context accelerates the emergence of limit pricing.

Table 4 provides formal statistical tests for these context effects. All of the regressions reported in this table are probits. To control for individual effects, all of the probits include a random effect term. This term is always statistically significant at the 1% level, but is suppressed in the table since it is of no economic interest. The dependent variable in the regressions is the occurrence of limit pricing, coded 1 if limit pricing occurred and 0 otherwise.[12] The first set of independent variables control for trends over time. Cycle 2 is a dummy for observations in the second cycle and Cycle 3 is a dummy for observations in the third cycle. The next set of variables control for context effects over time. The variable MC i is a dummy for meaningful context interacted with a dummy for cycle i. The final independent variable, Delta23, controls for the behavior of Es. For each M player in each period we calculate the observed entry rate differential between playing non-strategically and playing strategically for his/her type.[13] This entry rate differential proxies for the unobservable beliefs of Ms. We interact the entry rate differential

[12]More specifically, coded as 1 for output level 3 or greater for MHs and output level 5 or greater for MLs.

[13]For example, suppose we are considering an ML player in period 25. We take the difference between the observed entry rate for periods 1 - 24 following outputs 3 and 4 (non-strategic play for an ML) and the observed entry rate for periods 1 - 24 following outputs 5, 6, and 7 (strategic play for an ML). Note that these probabilities are conditioned on the output level selected, not the type of M which selects the output. These should be the probabilities which are relevant to an M.

with a dummy which equals 0 for cycle 1 and 1 for cycles 2 and 3. This interaction is used because the entry rate in unstable in early periods. Moreover, given that subjects enter the experiment with some prior beliefs and no experience, the entry rate differential probably serves as a poor proxy for beliefs in early periods. Table 4 reports parameter estimates for a variety of specifications with standard errors given in parentheses. Log likelihoods for each model are reported at the bottom of the table, and statistical significance for individual parameters is indicated in terms of a 2-tailed z-test.

[Insert Table 4 here]

The probit analysis confirms the impressions based on the raw data in Table 3. First, consider the probit analysis on MH data shown in the left panel of Table 4. Model 1 confirms that there is significant growth in levels of strategic play over time as indicated by the large, positive, and statistically significant coefficients for the cycle dummies. Given that this is the single most obvious feature of the data, it is reassuring to know that the probit analysis easily detects it. Model 2 shows that MHs respond strongly to differences in the incentives to limit price; this follows from the large, positive, and statistically significant coefficient for Delta23. This result is consistent with the predictions of the Cooper et al. learning model (as well as other learning models) – limit pricing develops primarily in response to high entry rate differentials. Comparing Model 3 with Model 2, the MC dummy has a statistically significant effect in the first cycle (5% level), with the effect trailing off noticeably over the second and third cycles of play.[14] Thus, MC accelerates the emergence of limit pricing by MHs, but does not affect the level of limit pricing in the long run.

Turning to the probit analysis for MLs, shown in the right panel of Table 4, Model 1 once again shows a significant growth in limit pricing over time. Model 2 finds that the level of limit pricing only depends weakly on the entry rate differential, failing to achieve statistical significance at even the 10%

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[14] The three MC dummies are not jointly significant at standard levels (÷^{2} = 4.52, 3 d.f). All tests of joint significance reported in this paper are log likelihood ratio tests.

level. This is not surprising. Since there are relatively few observations of strategic play by MLs, Delta23 will necessarily be a weaker proxy for MLs' beliefs than for MHs' beliefs. With the inclusion of MC dummies in Model 3, the effect of Delta23 vanishes entirely. The only significant context effect occurs in the third cycle (10% level), with MC boosting levels of strategic play for MLs.[15]

We expect the occurrence of strategic play by MLs in EH sessions to be a transient phenomenon, since the incentives are typically strongly in favor of a pooling equilibrium at 4. To confirm this prediction, we brought back randomly selected subjects for a second session, one with the GC treatment and one with the MC treatment. Subjects enrolled in the same treatment as they had participated in originally. Consistent with our expectations, there was virtually no strategic play by MLs in the experienced subject sessions. For the GC session, no example of strategic play by an ML was observed. In the MC session, only six observations of strategic play by an ML occurred (4.2% of all such observations).Thus, although meaningful context has a small impact on MLs in the experienced subject sessions, there is no evidence that it pushes play towards a separating equilibrium. Although the MC treatment gets MLs to consider limit pricing as a potential safe haven, the long term incentives in favor of non-strategic play are far to strong to induce MLs to deviate from the pooling equilibrium at 4.[16]

C. Game with Low Cost Entrants: Table 5 summarizes choice data from standard games with ELs. Note that this table includes data for the feedback treatment (generic instructions but with color coded and sorted feedback). Table 6 provides equivalent information for the zero anticipation treatment.

[Insert Tables 5 and 6 here]

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[15]The context dummies miss joint significance at even the 10% level (χ^2 = 4.80, 3 d.f.). The differing significance levels for Delta23 in Model 2 and Model 3 suggests correlation between Es' behavior and the presence of meaningful context. Indeed, in Table 3 we see that the entry rate in the third cycle following play of 5, 6, or 7 is about 13% lower in MC than in GC sessions. Formal tests do not find this difference to be significant, partially due to the small number of observations of strategic play by MLs.

[16]There was little difference between MH behavior in these two experienced subject sessions.

Looking at the standard games, there is considerably more limit pricing by MHs in the MC treatment for the first cycle of play (27% for GC versus 38% for MC). However, these differences disappear over time, almost an exact replication of the results reported in the previous section for EHs. There is also slightly more limit pricing by MLs in the MC treatment than in the GC treatment. The raw data for the feedback treatment suggests that it is not the color coding and sorting of feedback information that is responsible for the MC results since (1) except for cycle 3, the frequency of limit pricing for the feedback treatment is uniformly less than in the MC treatment and (2) the frequency of limit pricing in the feedback treatment is just as likely to be below the frequency in the GC treatment as above it.

The effects of MC in the zero anticipation treatment largely match the results in standard games. We observe more limit pricing by MHs in cycle 1 for games with MC (33% vs. 25%) and uniformly more limit pricing for MLs in games with MC (14% vs. 10% averaged over all three cycles). However, as anticipated, there is a uniformly lower frequency of limit pricing by MLs here compared to the standard games, regardless of the context.

The probit regressions in Table 7 compare GC with MC. Data from the standard game and the zero anticipation game are pooled. The models are identical to those employed in Table 4 except for the inclusion of a new set of dummies for the zero anticipation treatment (ZA_i = 1 for zero anticipation games in cycle i; = 0 otherwise). For MHs (left panel of Table 7), Model 1 shows the expected growth in strategic play over time. Model 2 confirms that MHs respond strongly to historic entry rate differentials (the Delta23 variable). For Model 3 MC_1 is positive and significant at the 1% level. Although neither MC_2 nor MC_3 are significant at even the 10% level, the signs of both are positive, and jointly, the three MC dummies are significant at the 10% level (χ^2 = 6.42, 3 d.f.). In contrast, none of the ZA dummies is individually significant in model 3, nor are they jointly significant. This is as anticipated, since the zero anticipation treatment is designed to only affect outputs 6 and 7, choices that are basically irrelevant for MHs.

[Insert Table 7 here]

The right side of Table 7 provides probits for MLs. Model 1 shows the increase in strategic play over time that is characteristic of the raw data. The Delta23 variable has the expected sign in model 2. In model 3, the three ZA dummies are all negative and jointly significant at the 10% level (χ^2 = 6.86, d.f. = 3), with ZA 3 significant at the 5% level and ZA 2 significant at the 10% level. Thus, as expected, the zero anticipation treatment significantly inhibits limit pricing by MLs. The signs of the MC dummies are all positive in model 3, indicating that meaningful context promotes strategic play by MLs. But the impact is not as strong as the ZA treatment itself, as only MC 1 is significant at the 10% level, and jointly the three MC parameters aren't significant at standard levels (χ^2 = 2.62, 3 d.f.).

Table 8 presents probits designed to distinguish the effects of meaningful context from the sorting and color coding of feedback that accompanied it. Data are pooled from all standard games with ELs, including the three feedback sessions. The models are similar to those employed in Tables 4 and 7 but include dummy variables for the feedback treatment (Feed i = 1 for the feedback treatment in cycle i, = 0 otherwise). For MHs (left panel of Table 8), none of the three feedback dummies are individually significant at standard levels, nor are the three dummies jointly significant at standard levels (χ^2 = 4.50, 3 d.f.). However, the MC i dummies in Model 2 are all positive with MC 1 significant at the 5% level and MC 2 significant at the 10% level, consistent with the results reported in Table 7. For MLs (right panel of Table 8), the Feed 1 dummy is *negative* in sign and significant at the 10% level, indicating that color coding and sorting of feedback *hindered* the development of strategic play. This seems inherently implausible and more than likely reflects either a statistical fluke or a simple reduction in random errors with clearer feedback. The three feedback dummies are not jointly significant at the 10% level (χ^2 = 6.12, 3 d.f.). Further, as in Table 7, the three MC dummies are all positive, but have less explanatory power for MLs compared to MHs.

[Insert Table 8 here]

In short, the results from Table 8 provide no evidence that color coding and sorting of feedback, by itself, systematically increases the level of strategic play compared to the generic sessions. Although this does not preclude some sort of strong interaction effect between color coding and sorting of feedback and meaningful context that is not identified through our experimental treatments, it definitely rules out color coding and sorting of feedback alone as being alone responsible for the increased levels of strategic play associated with the MC treatment.

Overall, the probit analysis of sessions with ELs matches the analysis with EHs. We find consistent effects from the MC treatment. These effects are largely confined to early periods for MHs, with little impact of meaningful context for MLs. Further, these effects cannot be attributed to the use of color coding and sorting of feedback employed in the MC treatment.

D. Strong Context Effects: All of the evidence we have analyzed thus far is consistent with the presence of weak context effects (meaningful context speeds up the adjustment process but does not fundamentally change the underlying reasoning). We also find some suggestion of strong context effects in the data (meaningful context fundamentally changes the reasoning process), although this evidence is far from conclusive.

[Insert Table 9 here]

Although the MC treatment does not have a strong effect on the frequency with which MLs limit price, it has a strong impact on the likelihood that MLs will *try and limit price at least once*. Table 9 breaks down the probability of an ML limit pricing at least once by treatment. Excluding the feedback sessions, only 55% of all subjects try to limit price even once as MLs.[17] However, in GC sessions the rate is 45% compared to 61% in MC sessions. Computing Z-statistics, these differences are significant at the 8% level (Z = 1.79, two-tailed test) for standard games with EHs and at the 5% level (Z = 1.94, two-

[17] By way of contrast 84%of all subjects play strategically at least once as MHs. We concentrate on behavior of MLs, since almost all subjects limit price at lease once as MHs.

tailed test) for standard games with ELs. Pooling the data for sessions with ELs and EHs the differences are highly significant ($Z = 2.83$, $p < .01$, two-tailed test).[18]

To the extent that an ML trying to limit price at least once involves a fundamental change in the reasoning process, the data in Table 9 provide evidence of strong context effects. It is clear from the structure of this game that trying to limit price as an ML is fundamentally different from trying to limit price as an MH. This follows from two observations. First, MHs immediately confront strong incentives to limit price, while MLs have weaker incentives which only gradually develop over time. For example, consider the first cycle in the standard game with ELs. For both MHs and MLs, a 13% entry rate differential between playing non-strategically and limit pricing is needed to induce strategic play. For MHs the observed entry rate differential is 29%, but for MLs the observed entry rate differential is only 11%. Thus, MLs receive less obvious cues to behave strategically than MHs. Second, when MHs limit price, they imitate, using strategies which are already being commonly used by MLs. When MLs limit price, they must innovate, using strategies which are largely unemployed. Therefore, the MHs have strong evidence that limit pricing will reduce the risk of entry while MLs do not, and MHs have the advantage of being able to imitate rather than having to innovate. All of this suggests that the MC treatment is getting subjects playing as MLs to think about an approach to the game which is less than obvious.

Additional evidence for strong context effects can be found from the zero anticipation treatment. As noted previously, this treatment retards the development of limit pricing and shifts limit pricing away from the intuitive outcome. This second effect, shifting limit pricing away from the intuitive outcome, is stronger in the GC treatment: Limit pricing occurred almost entirely at 5 in the GC treatment, but was evenly split between 5 and 6 in the MC treatment.

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[18]The probability of limit pricing at least once as an ML in the feedback sessions is not significantly different from the likelihood for GC sessions. Inclusion of this data in our analysis would have somewhat strengthened our conclusions.

Further, these effects tend to persist as evidenced from experienced subject sessions. Bringing subjects back from the GC sessions and enrolling them in the same treatment, in the third cycle 32% of MLs' play involved limit pricing. However, there was not a single play of the intuitive outcome! In contrast, experienced subjects under the MC treatment had both more limit pricing (42% versus 32%) and substantially more limit pricing at the intuitive outcome (32% versus 0%) in the third cycle of experienced subject play.

These results are consistent with the existence of strong context effects. Use of the intuitive outcome implies a fairly sophisticated chain of reasoning. Subjects not only need to realize that there are dominated strategies which neither they nor others will use, they also need to anticipate that other subjects will have the same realization. More concretely, subjects playing the intuitive outcome must anticipate that others will interpret a play of 6 as coming from an ML, since this is a dominated strategy for MHs. To the extent that increased play of the intuitive outcome in the zero anticipation sessions with MC reflects subjects having worked through this logic, it appears that meaningful context stimulates more sophisticated reasoning.

It must be stressed that this last result is only suggestive. We are talking about subtle effects with a relatively small amount of data. Even if the observed shift from limit pricing at 5 to limit pricing at 6 held up with a large sample, this would represent a second order effect. Even with meaningful context, the dominant features of the zero anticipation treatment remain how little limit pricing occurs and how little play of the intuitive outcome occurs. Even in the third cycle of the experienced subject session with MC, less than half of ML play involves limit pricing and less than half of all limit pricing occurs at the intuitive outcome. As a point of contrast, Cooper *et al* (1997b) report data from an experienced subject GC session for the standard game with ELs. In the third cycle, 85% of play by MLs involved limit pricing and virtually all of it occurred at the intuitive outcome of 6 (83% of total play by MLs, 97% of limit pricing). Thus, the effect of making payoffs positive for the dominant strategies overwhelms any effects due to the change in the contextual framework of the experiment.

E: Es' Behavior: Our analysis up to this point has concentrated on the behavior of Ms. We have also performed a complete analysis of Es' behavior. The details of this analysis are available from the authors upon request. In brief, statistical analysis of Es' behavior finds no context effects which cannot be explained as reactions to Ms' behavior. For example, consider Es' behavior in standard games with ELs. Looking at the lower part of Table 5, it appears that the MC treatment induces more mistakes by Es – they enter less frequently following non-strategic play by MHs (output 1 - 2) and more frequently following non-strategic play by MLs (output 3 - 4). However, this increase in mistakes is largely explained by the increase in limit pricing by MHs in the MC sessions, which gives Es greater incentive to enter following outputs 3 - 4.[19]

The minimal impact of the MC treatment on Es' behavior is consistent with our observation that meaningful context primarily affects play by accelerating subjects' learning processes. Compared to Ms, Es simply don't have much to learn. Following non-strategic play by an MH (outputs 1 - 2) or by an ML (outputs 3 - 4), Es are mainly doing the right thing even in the first cycle of play. The only place where accelerated learning might help an E is following strategic play by an ML (outputs 5 - 7). However, play of these outcomes is relatively rare, so that any such effects are unlikely to be observed in the data.

V. Conclusions and Discussion

The cognitive psychology literature finds that the presence of meaningful context can fundamentally affect the ability of experimental subjects to solve reasoning problems. If similar effects exist for the sophisticated reasoning problems inherent in game theory, the standard methodology of using generic context for game theoretic experiments is seriously flawed.

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[19]In the first cycle of play, the probability of an M being a MH type conditional on choice of 3 or 4 is 25.5% in GC sessions as opposed to 32.3% in MC sessions.

We report the results of a series of experiments designed to test for the effects of meaningful context in a signalling game experiment. We hypothesize that there may exist either weak context effects, speeding up subjects' reasoning processes but not fundamentally changing them, or strong context effect which fundamentally change subjects' reasoning processes.

The data indicate that general patterns of play are *not* fundamentally altered by the use of meaningful context: (1) A simple adaptive learning model better characterizes behavior than equilibrium theory regardless of the context employed, (2) Although meaningful context gets substantially more low cost monopolists to initially try a separating strategy in games where both pure strategy pooling and separating equilibria exit, it is not enough to counteract the strong incentives for a pooling as a result of entrants behavior, and (3) Although meaningful context promotes play of the intuitive outcome when we have purposely made it more difficult to identify (the zero anticipation treatment), this result is of second order importance to the fact that limit pricing is severely retarded regardless of context in this treatment. These results will, no doubt, give comfort to those economists who believe that deep structure is all that matters.

However, there is compelling evidence for the existence of weak context effects, primarily in terms of speeding up the emergence of limit pricing by high cost monopolists. Evidence for strong context effects exists as well, but is far from conclusive. We believe that context is an important and underappreciated role in the careful design and interpretation of economic experiments. Because of weak context effects, the use of meaningful context is likely to speed up convergence to equilibrium in economic experiments. This makes it far more likely that sharp results will be observed. It also implies that long run outcomes in experiments with meaningful context are more representative of what we would expect to see in field settings with their rich and meaningful context.

Finally, there are many cases where the underlying incentives favoring one equilibrium or another are not so strong as in the games explored here. Thus, if strong context effects exist, and we believe that they do, in games with weaker incentives favoring one equilibrium over another, we should be able to design an experiment in which switching between generic and meaningful context will alter the equilibrium outcome with no change in the underlying structure of the game. For example, one should be able to design an experiment in which switching between meaningful and generic context alone will determine whether or not Cho-Kreps intuitive criteria will or will not be satisfied. This is an exercise that remains to be conducted.

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Table 1a:
Monopolist Payoffs

High Cost Monopolist		
Monopolist Action	Entrant Response	
	IN	OUT
1	150	426
2	168	444
3	150	426
4	132	408
5	56	182
6	-188 *(38)*	-38 *(162)*
7	-292 *(20)*	-126 *(144)*

Low Cost Monopolist		
Monopolist Action	Entrant Response	
	IN	OUT
1	250	542
2	276	568
3	330	606
4	352	628
5	334	610
6	316	592
7	213	486

Note: Italicized numbers represent changes in payoffs made for the ZA treatment.

Table 1b:
Entrant Payoffs, High Cost Entrants

Entrant's Strategy	Monopolist's Type	
	High Cost	Low Cost
IN	300	74
OUT	250	250

Table 1c:
Entrant Payoffs, Low Cost Entrants

Entrant's Strategy	Monopolist's Type	
	High Cost	Low Cost
IN	500	200
OUT	250	250

Table 2

Summary of Treatments

	Generic Context Black and White, Unsorted Feedback	Generic Context Colored, Sorted Feedback	Meaningful Context Colored, Sorted Feedback
Standard Payoffs High Cost Entrants	2 sessions	No sessions	6 sessions
Standard Payoffs Low Cost Entrants	4 sessions*	3 sessions	6 sessions
ZA Treatment Low Cost Entrants	2 sessions	No sessions	2 sessions

* One session had only 24 periods.

Table 3

Summary of Results
Standard Game with High Cost Entrants

Proportion of Strategic Play by Ms

	MHs			MLs	
	GC	MC		GC	MC
Cycle 1	.289	.465		.122	.116
Cycle 2	.467	.518		.114	.178
Cycle 3	.565	.601		.068	.188

Entry Rate by Es

	GC				MC		
	Output 1 - 2	Output 3 - 4	Output 5 - 7		Output 1 - 2	Output 3 - 4	Output 5 - 7
Cycle 1	.551	.163	.077		.515	.234	.129
Cycle 2	.633	.158	.182		.543	.178	.070
Cycle 3	.600	.097	.167		.650	.171	.043

Table 4

The Effect of Meaningful Context on Frequency of Strategic Play
Standard Games with High Cost Entrants

MH Probits				ML Probits			
107 subjects, 963 observations				114 subjects, 1025 observations			
Variable	Model 1	Model 2	Model 3	Variable	Model 1	Model 2	Model 3
Constant	-.161 (.111)	-.195+ (.101)	-.566** (.219)	Constant	-1.961** (.196)	-1.943** (.200)	-1.736** (.473)
Cycle 2	.325** (.121)	-.777** (.273)	-.387 (.362)	Cycle 2	.344* (.161)	.071 (.226)	.077 (.621)
Cycle 3	.790** (.112)	-.460+ (.273)	.117 (.367)	Cycle 3	.297* (.131)	.094 (.198)	-.501 (.355)
MC 1	---	---	.560* (.255)	MC 1	---	---	-.258 (.497)
MC 2	---	---	.251 (.306)	MC 2	---	---	.116 (.404)
MC 3	---	---	.016 (.305)	MC 3	---	---	.781+ (.461)
Delta23	---	3.177** (.622)	2.755** (.646)	Delta23	---	2.360 (1.498)	-.102 (1.785)
Log Likelihood	-458.13	-450.32	-448.06	Log Likelihood	-291.35	-290.43	288.03

+ Significantly different from 0 at the 10% level
* Significantly different from 0 at the 5% level
** Significantly different from 0 at the 1% level

Table 5

Summary of Results
Standard Game with Low Cost Entrants

Proportion of Strategic Play by Ms

	MHs				MLs		
	GC No Sorting	MC Sorting	GC Sorting		GC No Sorting	MC Sorting	GC Sorting
Cycle 1	.276	.404	.354		.160	.175	.069
Cycle 2	.497	.513	.424		.209	.240	.153
Cycle 3	.539	.527	.590		.274	.310	.278

Entry Rate by Es

	GC, No Sorting				MC, Sorting		
	Output 1 - 2	Output 3 - 4	Output 5 - 7		Output 1 - 2	Output 3 - 4	Output 5 - 7
Cycle 1	.882	.527	.517		.798	.573	.400
Cycle 2	.935	.512	.410		.907	.605	.429
Cycle 3	.927	.577	.371		.880	.679	.402

	GC, Sorting		
	Output 1 - 2	Output 3 - 4	Output 5 - 7
Cycle 1	.696	.337	.273
Cycle 2	.864	.386	.208
Cycle 3	.906	.577	.238

Table 6

Summary of Results
ZA Treatment with Low Cost Entrants

Proportion of Strategic Play by Ms

	MHs			MLs	
	GC No Sorting	MC Sorting		GC No Sorting	MC Sorting
Cycle 1	.247	.333		.072	.126
Cycle 2	.635	.454		.096	.141
Cycle 3	.482	.457		.121	.148

Entry Rate by Es

	GC, No Sorting				MC, Sorting		
	Output 1 - 2	Output 3 - 4	Output 5 - 7		Output 1 - 2	Output 3 - 4	Output 5 - 7
Cycle 1	.831	.479	.429		.662	.529	.250
Cycle 2	.824	.608	.444		.848	.561	.357
Cycle 3	.940	.741	.500		.849	.652	.467

Table 7

The Effect of Meaningful Context on Frequency of Strategic Play
Standard Games with Low Cost Entrants and ZA Treatment

MH Probits				ML Probits			
196 subjects, 1715 observations				196 subjects, 1717 observations			
Variable	Model 1	Model 2	Model 3	Variable	Model 1	Model 2	Model 3
Constant	-.439** (.090)	-.498** (.092)	-.710** (.137)	Constant	-1.494** (.115)	-1.472** (.114)	-1.672** (.168)
Cycle 2	.486** (.077)	-.135 (.183)	.059 (.319)	Cycle 2	.323** (.099)	.251* (.101)	.418** (.146)
Cycle 3	.555** (.073)	-.052 (.170)	.179 (.324)	Cycle 3	.626** (.078)	.515** (.088)	.567** (.125)
MC 1	---	---	.493** (.166)	MC 1	---	---	.324+ (.192)
MC 2	---	---	.256 (.205)	MC 2	---	---	.056 (.207)
MC 3	---	---	.208 (.200)	MC 3	---	---	.217 (.195)
ZA 1	-.304+ (.175)	-.279 (.177)	-.274 (.190)	ZA 1	-.121 (.224)	-.144 (.227)	-.158 (.235)
ZA 2	.065 (.177)	.228 (.182)	.211 (.193)	ZA 2	-.337 (.229)	-.421+ (.227)	-.452+ (.233)
ZA 3	-.190 (.196)	-.023 (.198)	-.046 (.209)	ZA 3	-.469* (.215)	-.545* (.220)	-.553* (.224)
Delta23	---	2.096** (.549)	1.948* (.811)	Delta23	---	.845** (.293)	.871** (.323)
Log Likelihood	-1012.55	-1008.39	-1005.18	Log Likelihood	-681.50	-679.02	-677.71

+ Significantly different from 0 at the 10% level
* Significantly different from 0 at the 5% level
** Significantly different from 0 at the 1% level

Table 8

The Effect of Colored, Sorted Feedback on Frequency of Strategic Play
Standard Games with Low Cost Entrants

MH Probits			ML Probits		
186 subjects, 1619 observations			186 subjects, 1633 observations		
Variable	Model 1	Model 2	Variable	Model 1	Model 2
Constant	-.618** (.114)	-.675** (.158)	Constant	1.987** (.149)	-1.753** (.172)
Cycle 2	-.320 (.347)	-.079 (.360)	Cycle 2	.460** (.126)	.424** (.155)
Cycle 3	.029 (.364)	.091 (.378)	Cycle 3	.833** (.103)	.555** (.133)
MC 1	.455** (.171)	.518* (.202)	MC 1	.545** (.187)	.297 (.201)
MC 2	.642** (.221)	.476+ (.254)	MC 2	.255 (.223)	.039 (.244)
MC 3	.330 (.219)	.344 (.246)	MC 3	.204 (.180)	.231 (.222)
Feed 1	---	.133 (.243)	Feed 1	---	-.542+ (.290)
Feed 2	---	-.359 (.250)	Feed 2	---	-.409 (.293)
Feed 3	---	.028 (.239)	Feed 3	---	.101 (.263)
Delta23	2.095* (.899)	2.044* (.932)	Delta23	.936** (.315)	.978** (.320)
Log Likelihood	-937.80	-935.55	Log Likelihood	-641.03	-637.97

+ Significantly different from 0 at the 10% level
* Significantly different from 0 at the 5% level
** Significantly different from 0 at the 1% level

Table 9

Proportion of MLs Using Strategic Play at Least Once

	GC, No Sorting	GC, Sorting	MC, Sorting
Standard Payoffs High Cost Entrants	.333 (10/30)	---	.524 (44/84)
Standard Payoffs Low Cost Entrants	.517 (30/58)	.458 (22/48)	.713 (57/80)
ZA Treatment Low Cost Entrants	.429 (12/28)	---	.600 (18/30)

Figure 1

Standard Payoffs with High Cost Entrants, Generic Context Sessions

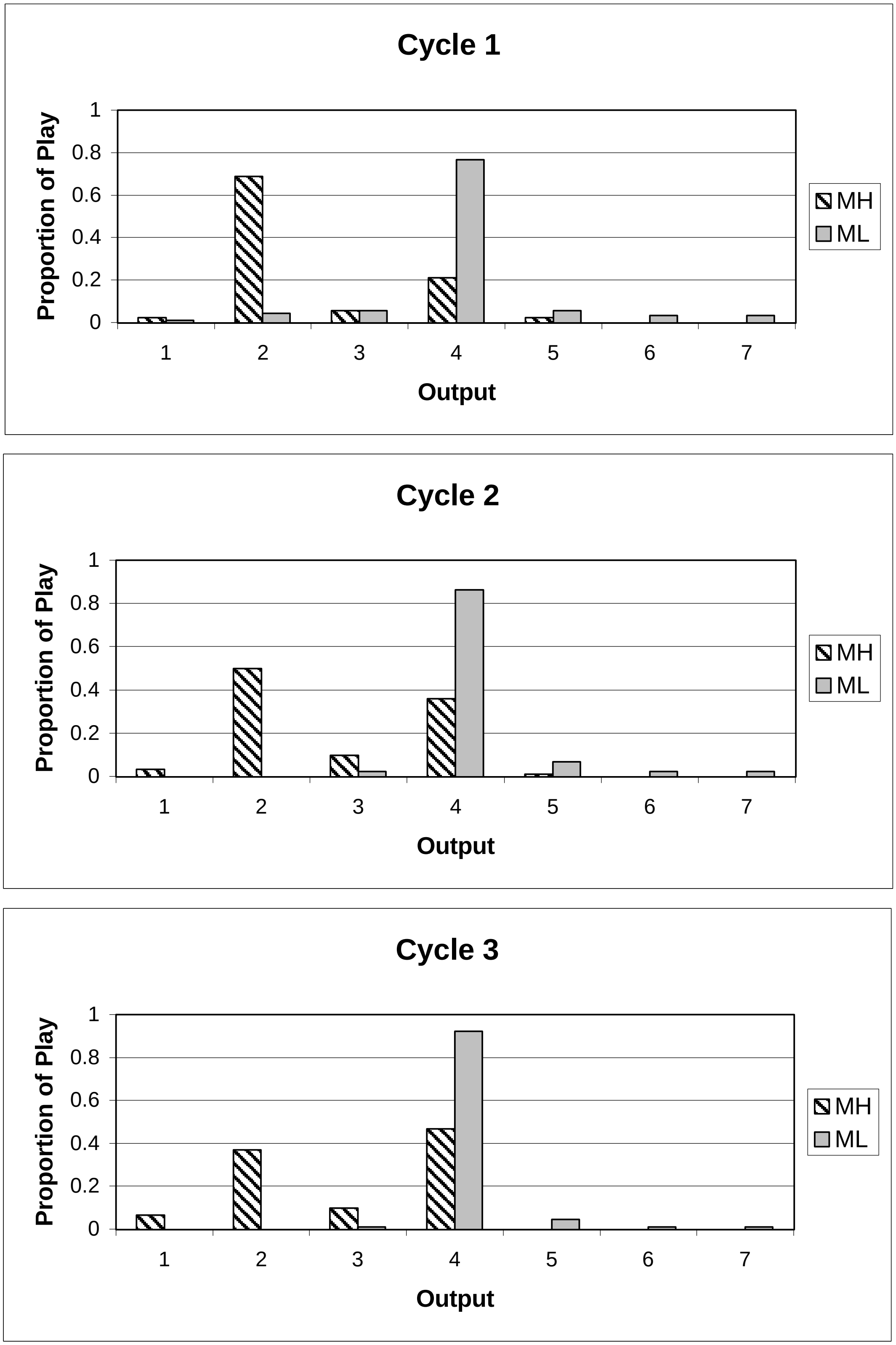


Figure 2

Standard Payoffs with High Cost Entrants, Meaningful Context Sessions

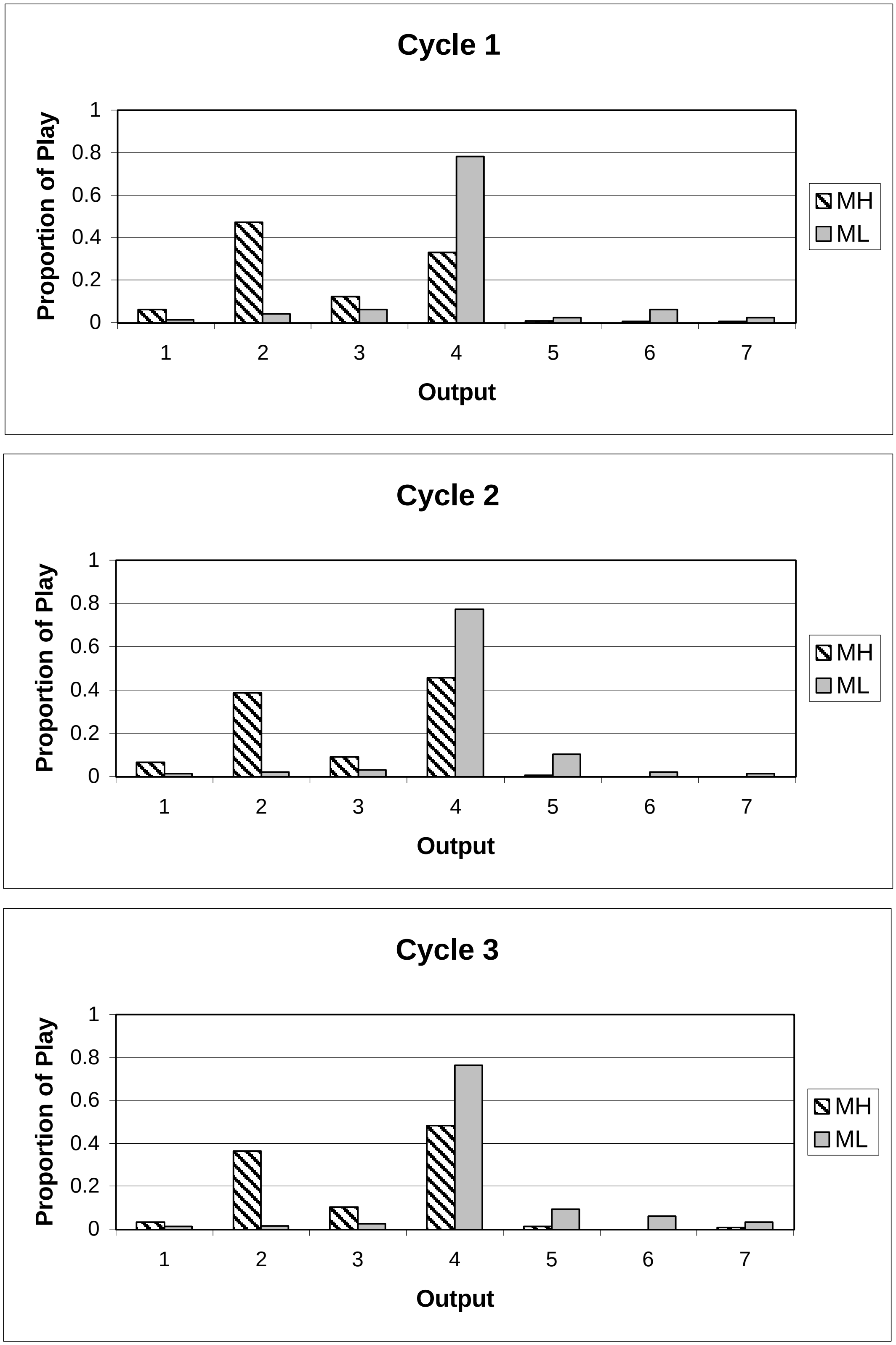


Figure 3

Standard Payoffs with Low Cost Entrants, Generic Context Sessions

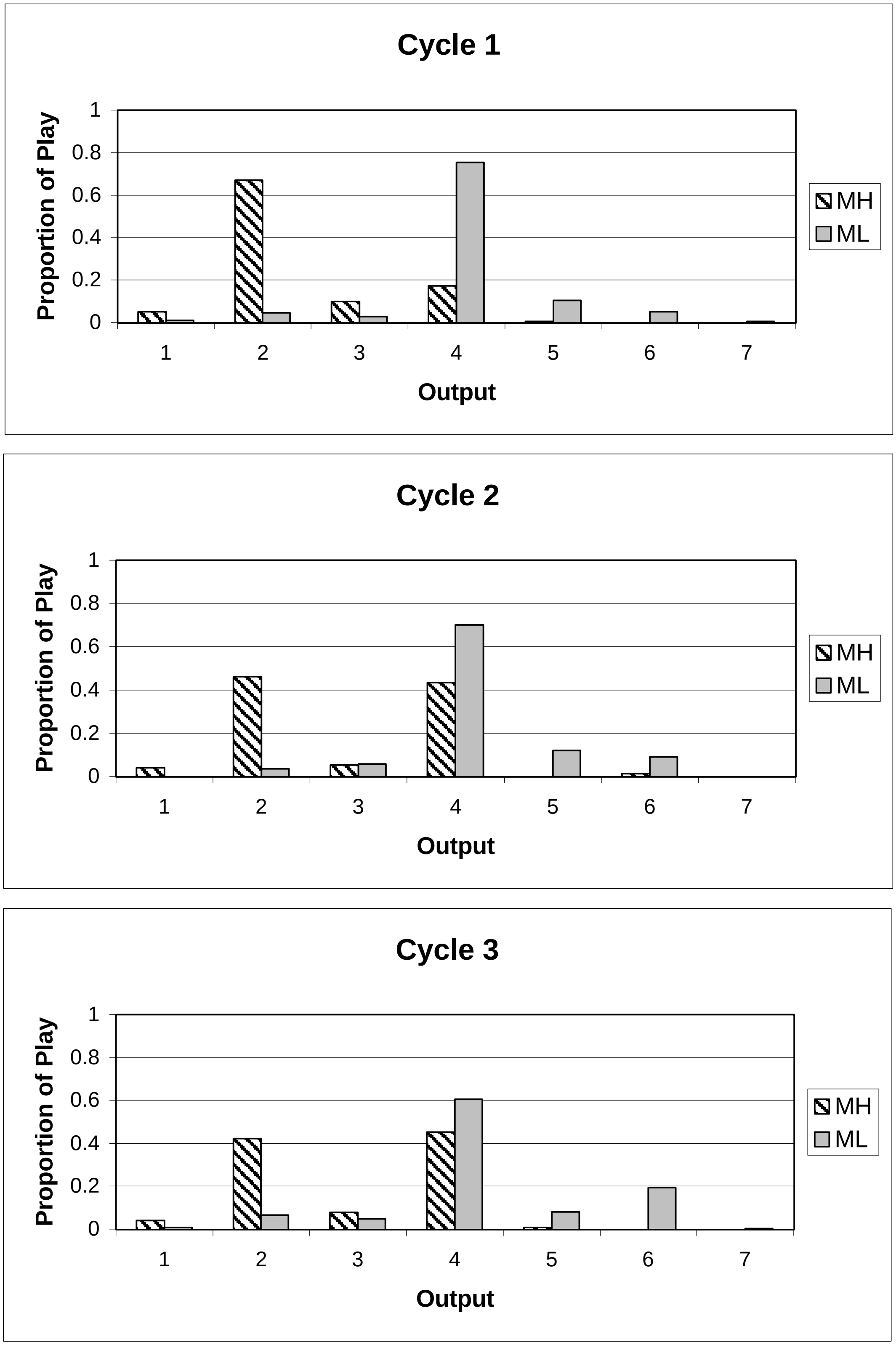
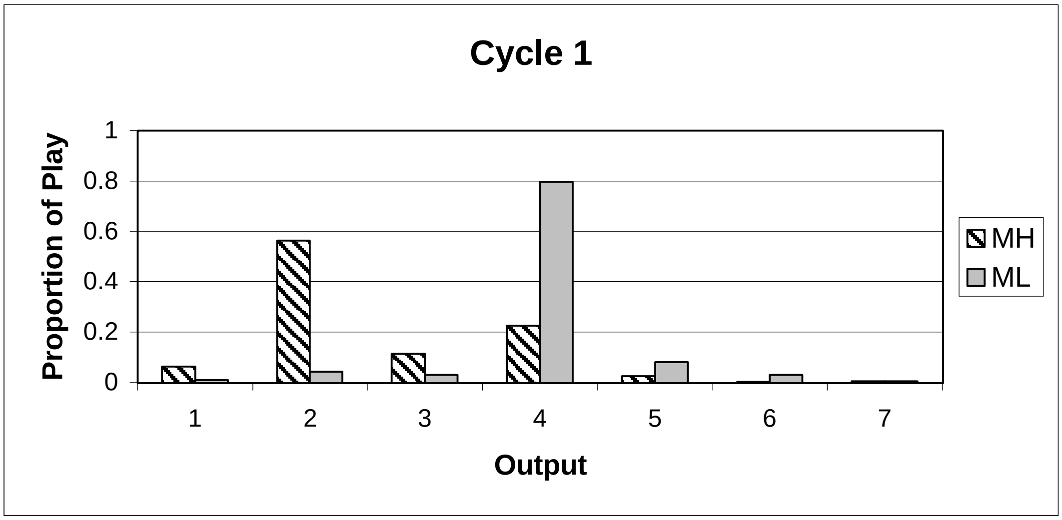
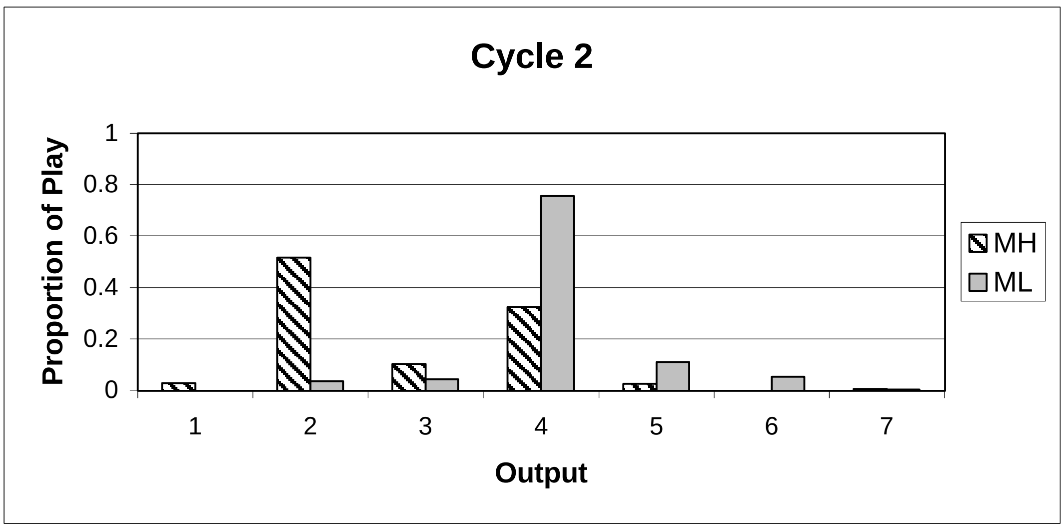


Figure 4

Standard Payoffs with Low Cost Entrants, Meaningful Context Sessions





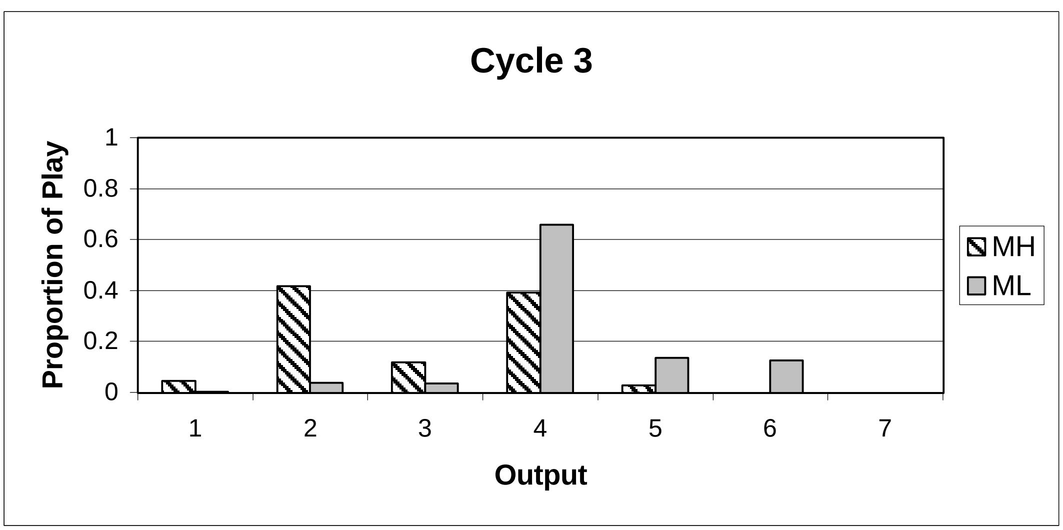


Figure 5

ZA Treatment, Generic Context Sessions

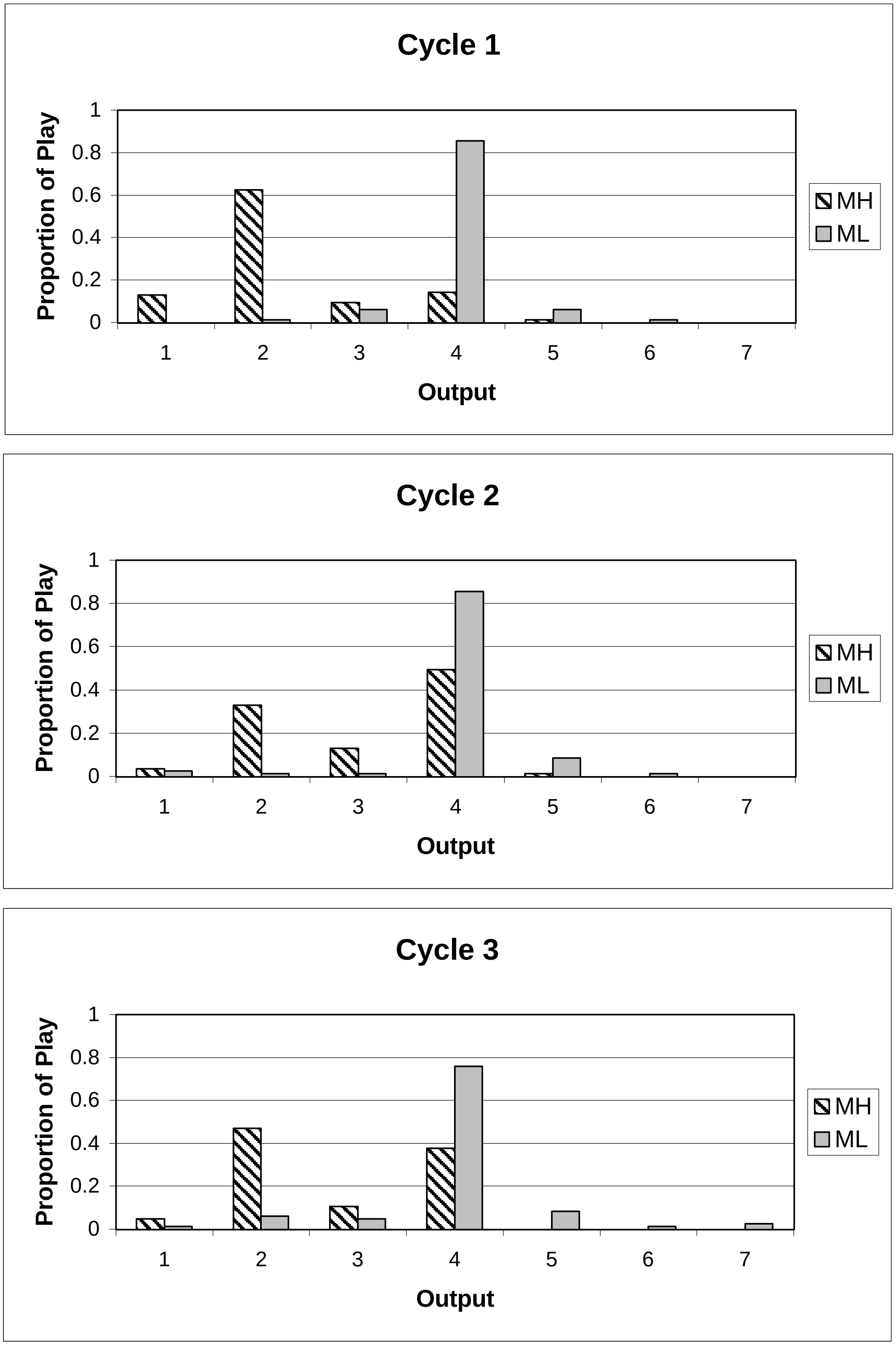


Figure 6

ZA treatment, Meaningful Context Sessions