Stackelberg in the Lab: The Effect of Group Decision Making and Deliberation Periods*

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Abstract

The Stackelberg duopoly is a fundamental model of sequential output competition. The equilibrium outcome of the model results in first mover advantage where the first-moving firm produces more output, and earns larger profits, relative to the second-moving firm. Huck, Müller, and Normann (2001) and Huck and Wallace (2002) test the Stackelberg duopoly in a lab setting and find behavior that is largely inconsistent with the equilibrium predictions of the model. We hypothesize that this inconsistency is a result of differences between the decision making environment implemented in the lab and firm environments in the field. In this paper, we experimentally investigate whether group decision making and decision deliberation periods lead to more profit maximizing Stackelberg behavior in the lab. In doing so, we re-test the Stackelberg duopoly in the lab while implementing (i) two-person decision making groups, and (ii) a 10-minute deliberation period for second movers. Our results suggest group decision making leads to more profit maximizing behavior for first movers, while the 10-minute deliberation period has very little effect on behavior of second movers.

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1 Introduction

The Stackelberg model is a fundamental and frequently applied model of sequential oligopolistic output competition. The subgame perfect equilibrium (SPE) outcome, assuming a symmetric duopoly, is asymmetric with the first-moving firm producing a larger output level, and earning larger profits, relative to the second-moving firm; A phenomenon referred to as the first mover advantage. However, the results from previous laboratory experimental investigations of the Stackelberg model are, in general, inconsistent with the SPE predictions (Huck, Müller, and Normann 2001 (HMN); Huck and Wallace 2002 (HW)).[1] Specifically, HMN find that second movers fail to best respond by choosing non profit maximizing output levels. Similarly, first movers fail to choose their profit maximizing output level, relative to both the SPE prediction and the empirical best response of second movers.

Both HMN and HW cite social preferences and/or emotional motivations as the primary explanations for the observed deviations from the SPE outcome. In particular, inequality aversion, e.g. Fehr and Schmidt (1999), would lead to lower than predicted output levels for first movers and flatter than predicted best response functions by second movers.[2] HW also note that reciprocity motivations can explain the theoretically inconsistent best responses of second movers.[3] How should such insights be interpreted in the context of firm decision making in the field? Would we expect firms to fail to exploit their first mover advantage because of preferences for equality? Would we expect firms to fail to choose the profit maximizing best response because of preferences for equality or reciprocity?

We hypothesize that the inconsistency between the SPE predictions of the Stackelberg model and the experimental results of HMN and HW are a result of differences between the lab environment and firm decision making environments in the field. In particular, we concentrate on two dimensions along which the decision making environment in the lab differs from that of firms in the field: (i) the size of the decision making unit, and (ii) the length of the decision deliberation period. Both HMN and

[1] Endogenous timing variation of the Stackelberg model (Hamilton and Slutsky 1990) have been tested experimentally and the results are also, in general, inconsistent with the theoretical predictions (see Huck, Müller, and Nornamm 2002; Fonseca, Huck and Normann 2005; and Fonseca, Müller, and Normann 2006).

[2] Lau and Leung (2006) re-examine the data from HMN and show that the data is consistent with a simplified version of the Fehr and Schmidt model of inequity aversion. The authors find that more than 1/3 of the subjects exhibit disadvantageous inequity aversion.

[3] The authors note that second movers "quite calmly plan to punish leaders in case they try to exploit their strategic adavantage and, at the same time, they are willing to not to exploit cooperative moves by the leader" (pp. 1). Although the authors do not explicitly refer to the second movers' preferences for reciprocity, this explanasion for the behavior of the second mover is consistent with the notion of reciprocity later modeled by Dufwenberg and Kirchsteiger (2004). Hence, I refer to this type of second mover behavior as reciprocity.

HW use a lab environment where individual decision makers act as firms, and there is very little time for decision deliberation.[4] However, we contend that important firm decisions in the field, e.g. output decisions, are likely to be discussed (formally or informally) and jointly decided upon by a committee of executive (see Messick, Moore, and Bazerman 1997; Cox 2002; and Kocher and Sutter 2005; Cox and Hayne 2006). Similarly, important firm decisions are likely to carefully considered and made after a period of deliberation.

The motivation of this paper is to investigate the impact of group decision making and deliberation periods on Stackelberg behavior in the lab. Specifically, we test whether group decision making and deliberation periods lead to more profit maximizing Stackelberg behavior in the lab. In doing so, we experimentally re-test the Stackelberg duopoly using a lab environment that is augmented along the following two dimensions: (1) *firm* decisions are made by 2-person groups, and (2) the second moving *firm* makes its decision after a 10-minute deliberation period. By implementing a lab protocol that uses group decision making and deliberation periods, we aim at creating a lab environment that *better* represents firm decision making environments in the field. We hypothesize that this will lead to decisions in the lab that are more in line with profit maximization and, consequently, more in line with the SPE predictions of the Stackelberg model.

Clearly, the size of the decision making unit and the length of the deliberation period do not fully exhaust the set of differences between decision making environments in the lab and firm environments in the field.[5] However, we concentrate on the impact of these two dimensions for two important reasons. First, a growing body of literature (discussed thoroughly in the subsequent section) suggests that both group decision making and deliberation periods can mitigate the influence of social preferences and emotional motivations, resulting in more *selfish* decision making. In the context of a Stackelberg model, selfish decision making corresponds to profit maximizing decision making, which would lead to behavior more in line with the SPE predictions. Second, the size of the decision making unit and the time between decisions can both be practically augmented in a lab environment. Thus, it is possible to experimentally investigate the impact of group decision making and deliberation periods on Stackelberg behavior in the lab.

Laboratory experiments provide a controlled environment and, as a result, are a useful research tool for gaining valuable insights regarding behavior in naturally occurring economic environments (Falk and Heckman 2009). Such experimental insights may be of particular value when investigating industrial organization models

[4]The environment used by HMN and HW is prototypical of many lab experiments and is consistent with what Harrison and List (2004) would consider a "conventional lab experiment".

[5]See Harrison and List (2004), and Levitt and List (2007) for a discussion of other environmental dimesions along which the lab and the field differ.

(see Normann and Ruffle 2011 for a discussion). However, one of the major concerns with lab experiments is the limited extent with which the results from the lab can be extrapolated to behavior in the field (Levitt and List 2007). Levitt and List note that "perhaps the most fundamental question in experimental economics is whether findings from the lab are likely to provide reliable inferences outside of the laboratory" (pp. 170); A concept Levitt and List refer to as the *generalizability* of a lab experiment.[6] We assert that the generalizability of lab results relating to firm behavior is particularly tenuous due to the differences in the substantial decision making environment between the lab and the field, which include the size of the decision making unit and the length of the decision deliberation period.[7]

Gneezy and List (2006) argue that, "before we can begin to make sound arguments that behavior observed in the lab is a good indicator of behavior in the field, we must explore whether certain dimensions of the laboratory environment might cause differences in behavior across these domains" (pp. 1381). We take a first step, in relation to a Stackelberg model, by investigating the effect of group decision making and deliberation periods in the lab. Both of which, we contend, are representative characteristics of firm decision making environments in the field. Implementing a lab environment that is *closer* to firms in the field can, in turn, help increase the generalizability of lab results (Friedman and Sunder 1994). Although we study an experimental Stackelberg duopoly, the results from this study can provide insights regarding the effect of group decision making and deliberation periods in other experiments that investigate models of firm specific decision making. Thus, as a broader methodological contribution, we hope this study can be informative to the design of future laboratory experiments relating to firm specific models, e.g. entry, pricing, mergers, R&D, and advertising.

This paper proceeds by discussing relevant literature in Section 2. We present the experimental design and develop testable research hypotheses in Section 3. The results are presented in Section 4, and Section 5 concludes with discussion.

2 Related Literature

2.1 Group Decision-making

The literature relating to group decision making, and the comparison with individual decision making, is extensive and spans many disciplines including economics and

[6] Other terms have been used in reference to the extrapolation of lab results to the field, including *external validity* (Campbell and Stanley 1963) and *parallelism* (Wilde 1981; Smith 1982).

[7] We are by no means implying that the size of the decision making unit and the length of the deliberation period between decisions fully exhaust the set of differences between firm environments in the lab and in the field. We refer the reader to Harrison and List (2004) and Levitt and List (2007) for a discussion of other characteristics along which the lab and the field differ.

social psychology. Several studies have documented significant differences between group behavior and individual behavior for a wide range of decision making environments. In general, the results from these studies suggest that decisions made in groups are more self-interested compared to decisions made by individuals. In what follows, we provide a brief outline of relevant literature. This is not intended as a complete survey of all prior group decision making literature. We refer interested readers to Insko and Schopler (1987) and Kocher and Sutter (2007) for a more thorough reviews of the literature relating to group decision making.

Social psychologist refer, generally, to the difference between group decision making and individual decision making as the "discontinuity effect" (Brown 1954). This discontinuity effect has been extensively documented is many experimental studies. In a series of related studies, McCallum et al. (1985), Insko et al. (1987, 1988, 1990, 1994), and Schopler et al. (1991, 1993) find that groups, in general, exhibit significantly more competitive behavior than individuals in various prisoners' dilemma games. Insko et al. (1987) posit two plausible hypotheses to explain the more competitive behavior exhibited by groups. The first, "social support of self-interested competitiveness", suggests that groups provide shared support to other members in the group for acting in a self-interested, or competitive, manner. The second, "schema-based distrust", suggests that groups form beliefs that other groups will behave more competitively. Consequently, because groups perceive other groups to be more competitive, they are more competitive themselves.[8]

Several economic studies have similarly documented differences between group decisions and individual decisions, across a broad range of games. The results from these studies also find that group decisions are more self-interested and/or more competitive than individual decisions; Hence, group decisions are closer to the standard game theoretic predictions. For example, Robert and Carnevale (1997) and Bornstein and Yaniv (1998) find that groups make significantly higher demands in an ultimatum game, relative to individuals. Bornstein et al. (2004) considered a centipede game and find that groups chose to end the game at an earlier stage, relative to individuals, in both the increasing and constant sum versions of the game. Kocher and Sutter (2005) find that groups converge to lower guesses and earn higher profits in a repeated guessing game, relative to individuals.[9] Cooper and Kagel (2005) considered several versions of a limit pricing signaling game and find that groups exhibit more "strategic" behavior than individuals. Kugler et al. (2007) and Cox (2002) compare groups

[8]These two hypotheses are in opposition to the Social Comparison Theory referred to by Cason and Mui (1997). This theory suggests that people are motivated to present themselves to the group in a socially desirable way. This may push the behavior of the group toward more other regarding behavior. We address this theory in more detail in the conclusion, and as it relates to our results.

[9]In a follow up study, Sutter (2005) finds that groups of four make significantly lower guess, relative to groups of two and individuals in the guessing game. However, the author does not find a significant difference between groups of two and individuals.

decisions with individual decisions in a trust game; The former study find that group senders send less than individuals, while the latter study finds that group receivers return less than individuals.

To summarize, most of the prior experimental studies have found that group decision making is more self-interested and/or more competitive than individual decision making.[10] Recall, HMN and HW find Stackelberg behavior in the lab that is inconsistent with theoretical predictions, which the authors argue is in large part a result of other-regarding motivations. In light of the psychological theories and the results from the studies described above, we hypothesize that implementing group decision making in a Stackelberg game will lead to more self-interested behavior. Our paper contributes to this body of experimental literature by investigating the impact of group decision making in a Stackelberg game, which to the best of our knowledge has yet to be explored.

2.2 Deliberation Periods

Classical economics assumes that agents are calm, self-interested, flawless decision makers. However, a growing body of behavioral economics research suggests that psychological and emotional factors can influence decision makers, and consequently economic outcomes (Loewenstein 2000; and Sanfey et al. 2003). Emotional influences in decision making have been explored formally using dual-system models (see Kahneman 2003 for a review). The general idea is that human decision making is governed by an interaction between a "hot" system that responds to emotions and a "cold" system that responds to reason.

One possible way to mitigate the influence of emotions in decision making is to delay the decision, i.e. take a break and deliberate (Goleman 1995 and Adler et al. 1998). The idea is that delaying the decision allows time for emotional motivations to "cool-off". Or alternately, the deliberation period allows time for the cold system to analyze the problem and make a well thought decision. The idea that emotional motivations cool-off when agents are allowed time to deliberate has been documented experimentally. In a recent study, Oechssler et al. (2008) investigate how a cooling-off period affects rejection rates in an ultimatum game. The authors find that after a 24-hour deliberation period, a significant number of subjects who had initially rejected and unfair offer switch and accept the offer. Similarly, Grimm and Mengel (2011) find that a 10-minute deliberation period reduces rejection rates by about 1/2 in an ultimatum game; rejection rates fall from 80% in standard treatments to around 40-60% when the 10-minute deliberation period for responders was implemented.

[10] There exists one notable exception. Cason and Mui (1997) found that group behavior was less self-interested in a dictator game. That is, groups gave significantly more as the dictator compared to individuals. However, Luhan, Kocher and Sutter (2009) replicated the design of Cason and Mui and found contradictory results, i.e. group dictators gave significantly less than individuals.

Recall, HMN and HW cite negative reciprocity as one explanation for why second movers in their study do not best respond. The general idea behind reciprocity (Dufwenberg and Kirchsteiger 2004) is that agents are motivated to respond to the kind actions of others with kind actions (positive reciprocity), and respond to unkind actions with unkind actions (negative reciprocity), even at the expense of their own material payoff. We hypothesize that delaying the decision of second movers, via a 10-minute deliberation period, will mitigate reciprocal motivations, which in turn will lead to more profit maximizing behavior by second movers. The results from this study can be viewed as complementary to Oechssler et al. (2008) and Grimm and Mengel (2011).

3 Experimental Design

In this section, we first describe the experimental Stackelberg duopoly around which the design is based. We then describe the experimental treatments and outline the experimental procedure. Lastly, we develop a set of testable hypotheses aimed at answering the primary the research questions of this paper. Namely, does group decision making and deliberation periods lead to more profit-maximizing Stackelberg behavior?

3.1 The Model

We consider a symmetric, exogenous timing, Stackelberg duopoly with the same parameterization used by HMN and HW. In the model, there are two quantity setting firms, call them Firm A and Firm B. Let q_a and q_b denote each firm's output choices, respectively, and let $Q = q_a + q_b$ be the total market output. The market price is given by the inverse demand function:

$$P(Q) = \max\{30 - Q, 0\} \text{ where } Q = q_a + q_b$$

and each firm faces a linear cost of production given by:

$$C_i(q_i) = 6q_i, i = a, b$$

The firms choose their quantities sequentially. Firm A (the first mover) begins by choosing its output level – q_a. Then, after observing q_a, Firm B (the second mover) chooses its output level – q_b. The SPE is given by ($q_a = 12$, $q_b(q_a) = 12 - q_a/2$). Thus, the Stackelberg equilibrium outcome (SE) is $q_a = 12$ and $q_b = 6$ yielding equilibrium profits of $\pi_a = 72$ and $\pi_b = 36$. The Cournot equilibrium outcome (CE) is $q_a = q_b = 8$ yielding profits of $\pi_a = \pi_b = 64$, and the joint profit maximizing outcome (JPM) is $q_a = q_b = 6$ yielding profits of $\pi_a = \pi_b = 72$.

Similar to HMN and HW, we use a discretized action set of the above Stackelberg game with nine possible quantity choices $q_i \in \{5, 6, 7, 8, 9, 10, 11, 12, 13\}$ for $i = a, b$.

This action space allows for the possibility of the SE, CE, and JPM. Table 1 below displays the corresponding payoff matrix. Note, discretizing the action space induces multiple equilibria in this Stackelberg game. To ensure uniqueness of the Stackelberg and Cournot equilibrium, we employ the same method as HMN and HW and manipulate the payoff table slightly by subtracting one from 10 of the 162 entries.

TABLE 1: DISCRETE STACKELBERG PAYOFF MATRIX

		Firm B								
		5	6	7	8	9	10	11	12	13
	5	70,70	65,78	60,84	55,88	50,89	45,90	40,88	35,84	29,78
	6	78,65	72,72	66,77	60,80	54,81	48,80	41,77	36,72	30,65
	7	84,60	77,66	70,70	63,72	55,71	49,70	42,66	35,60	28,52
	8	88,55	80,60	72,63	64,64	56,63	48,60	40,55	32,48	24,39
Firm A	9	89,50	81,54	71,55	63,56	54,54	45,50	36,44	27,36	18,26
	10	90,45	80,48	70,49	60,48	50,45	40,40	30,33	20,24	10,13
	11	88,40	77,41	66,42	55,40	44,36	33,30	22,22	11,12	0,0
	12	84,35	72,36	60,35	48,32	36,27	24,20	12,11	0,0	-12,-13
	13	78,29	65,30	52,28	39,24	26,18	13,10	0,0	-13,-12	-26,-26

3.2 Experimental Treatments

The experiment consisted of three treatments, which we refer to as: (i) Baseline, (ii) Group, and (iii) Deliberation. We implement a between groups design and each subject participated in only one treatment. The three treatments are as follows:

Baseline (Treatment B) The baseline treatment involves subjects playing the discretized Stackelberg game once in either the role of Firm A or Firm B. The baseline treatment is intended to establish a baseline measure of the departures from equilibrium under an environment similar to the one used by HMN and HW, i.e., a standard lab environment protocol.

Group (Treatment G) Here we used the same setup and procedure as Treatment B, but, the decision-making units consisted of 2-person groups. Each 2-person group is responsible to make one quantity decision for the group. No explicit instructions or rules were provided to govern how the group made its decision.

Deliberation (Treatment D) Here we used the same setup and procedure as Treatment B except subjects playing the role of Firm B were required to take a 10-minute deliberation period before making their response decisions.

A simple questionnaire of approximately 10 minutes in length is administered in all treatments to all subjects (a copy of the questionnaire in included in the Appendix). In Treatment D, the questionnaire takes place after Firm A's decision is revealed to Firm B, but before Firm B responded. Hence, the 10-minutes spent answering the questionnaire serves as the deliberation period. In Treatment B and Treatment G, the questionnaire takes place after Firm B's decision. As a result, subjects in all treatments spent approximately the same amount of time in the experiment. Using a 10-minute questionnaire to serve as the deliberation period is in line with the protocol implemented by Grimm and Mengel (2011). In all treatments, the subjects were informed in the instructions that they would be required to complete a questionnaire.

3.3 Experimental Procedure

All experimental sessions were conducted in the Economic Science Laboratory (ESL) at the University of Arizona. The subjects were undergraduates recruited via an online database. All sessions were programmed using z-Tree (Fischbacher 2007).[11] In total, 192 subjects participated, 50 in Treatment B (25 markets), 92 in Treatment G (23 markets), and 50 in Treatment D (25 markets). Each subject participated in only one treatment, and each experimental session consisted of only one treatment. The average experimental earnings per subject, including the $3 show-up payment, was $9.49.[12]

Upon entering the lab, subjects were seated at individual carrels to prevent communication, except in Treatment G where subjects were allowed to communicate with their decision making partner. Subjects were randomly assigned either the role of Firm A or Firm B. The instructions were read aloud to all subjects (A copy of the player's instructions can be found in the Appendix). Subjects were also given the payoff matrix and made aware of the 10:1 conversion rate into dollars. After reading the instructions, subjects were given 2 minutes to familiarize themselves with the payoff matrix. Before the decision task began, subjects were required to correctly answer 2 questions about the payoff matrix to ensure their understanding of it.

The framing of the decision task was in line with HMN. Namely, participants were told that they were to act as a firm that, together with another firm, produces a homogeneous product to serve the market demand. Their output decision, along with the output decision of their rival firm, would determine the profits to each firm. Because our primary research motivation is to test the Stackelberg model in an environment more consistent with that of real firms, we feel it is appropriate to include firm specific framing as part of the experimental design.

[11] We are grateful to Urs Fischbacher for providing the software for these experiments.

[12] The $3 show-up payment is on the lower end of the spectrum, however, each experimental was quite short, lasting less than 25 minutes. Hence, we feel that a $3 show-up payment and $9.49 average total earnings was suitable compensation.

3.4 Testable Hypotheses

The motivation of this study is to investigate whether group decision making and deliberation periods lead to more profit maximizing Stackelberg behavior in the lab. To do so, we analyze the behavior of first movers and second movers separately. For second movers, profit maximizing behavior is rather straightforwardly characterized by best responding to the first mover. Thus, if group decision making leads to more profit maximizing Stackelberg behavior, then groups acting as second movers would be more likely to best respond. Similarly, if deliberation periods lead to more profit maximizing Stackelberg behavior, then second movers who have time to deliberate would be more likely to best respond. This leads to the following two testable hypotheses:

H1: The response quantities of Firm Bs in Treatment G are *closer* to the best response output quantity, compared to Treatment B.

H2: The response quantities of Firm Bs in Treatment D are *closer* to the best response output quantity, compared to Treatment B.

For first movers, profit maximizing behavior is less straightforward. Recall, that the SPE prescribed that Firm As choose a quantity of $q_a = 12$. Clearly, choosing $q_a = 12$ would characterize profit maximizing behavior *if* second movers choose the profit maximizing best response. However, if second movers do not best respond, then choosing $q_a = 12$ will likely not be the profit maximizing output level. To account for the possibility that second movers in our experiment may not be best responding, we characterize profit maximizing behavior for first movers as follows. First, we estimate the empirical response function from the observed second mover decisions for each treatment. Second, we calculate the profit maximizing first mover output level, given that second movers will respond according to the empirical response function; We refer to this as the conditional profit maximizing first mover output level and denote it as $\widehat{q}_a$. If group decision making leads to more profit maximizing Stackelberg behavior, then groups acting as first movers would choose quantities that are *closer* to $\widehat{q}_a$. This leads to the following hypothesis:

H3: First movers in the Treatment G choose output levels that are *closer* to $\widehat{q}_a$, compared to first movers in Treatment B.

We are only imposing the 10-minute deliberation period for second movers (Treatment D) and, therefore, we do not develop any testable prediction regarding first mover behavior for Treatment D. We hypothesize that the deliberation period will serve as a sort of cooling-off period, which will mitigate the influence of emotional motivations, e.g., reciprocity and/or spite. Hence, our motivation to only consider the 10-minute deliberation period for the second movers, who are susceptible to these motivations. In general, there could exist an indirect effect of the second mover deliberation period that feeds back to first mover behavior in Treatment D. Although, the data presented in the next section reveals little support for such an indirect effect.

4 Results

We begin by looking at the breakdown of market outcomes across the three treatment. We classify the outcomes into the following 4 categories: Stackelberg Equilibrium (SE) where $q_a = 12$ and $q_b = 6$, Cournot Equilibrium (CE) where $q_a = 8$ and $q_b = 8$, the Joint Profit Maximizing Outcome (JPM) where $q_a = 6$ and $q_b = 6$, and (OTHER) as any other outcome. Table 2 presents the breakdown of market outcomes by treatment.

Table 2: Market Outcomes: All Treatments

Outcome	Treatment B	Treatment G	Treatment D	Total
SE	1	0	1	2
CE	2	3	2	7
JPM	0	2	0	2
Other	22	18	22	62
Total	25	23	25	73

From Table 2, we can see that of the 73 total markets, there were 2 SE outcomes, 7 CE outcomes, 3 JPM outcomes, and 61 OTHER outcomes. Additionally, there are no significant differences in any of the four outcomes considered in Table 2 across the three treatments. It is clear from Table 2 that the data is inconsistent with the theoretically predicted Stackelberg Equilibrium outcome, for all three treatments. Recall, however, that deviations from the Stackelberg Equilibrium outcome can result if either the first mover fails to choose $q_a = 12$, or the second mover fails to best respond. We proceed by separately investigating the behavior of first movers and second movers across the three treatments, which allows us to test H1-H3.

4.1 Second Mover Response Data

The theoretical prediction of the Stackelberg duopoly is that second movers will choose the profit maximizing response quantity profits. Our first two hypotheses, H1 and H2, stated that second movers in Treatment G and Treatment D will choose quantities that are closer to the best response quantity than second movers in Treatment B, respectfully. To test each of these hypotheses, we use the following three metrics: (i) the percentage of second movers who chose the best response quantity – BR Rate, (ii) the absolute deviation from the best response quantity – Abs Dev from BR, and

(iii) the percentage of best response profits earned from their actual quantity choice – % of BR Profits.

Table 3 presents the aggregate second mover data for each treatment. *Panel A* displays the aggregate response data for all second movers by treatment. Comparing the second mover response data from Treatment B and Treatment G, we see that 10/23 (43%) best responded from Treatment G and 12/25 (48%) best responded from Treatment B, which is not significant using a 1-sided Fisher's Exact test (p = 0.755). Similarly, the average absolute deviation from the best response quantity is 1.30 in Treatment G compared to 1.16 in Treatment B, which is not significant using a 1-sided Mann-Whitney test (p = 0.653). Additionally, the percentage of best response profits was 92% for Treatment G and 91% in Treatment B, which again is not significant using a 1-sided Mann-Whitney test (p = 0.381). Taken together, these results suggest that second movers from Treatment G do not choose quantities that are closer to the profit maximizing best response, compared to second movers from Treatment B. Hence, the data fails to support H1.

Comparing the second mover data from Treatment D and Treatment B, we see that 10/25 (40%) best responded in Treatment D and 12/25 (48%) in Treatment B, which is not significant using a 1-sided Fisher's Exact test (p = 0.612). Similarly, the average absolute deviation from the best response quantity is 1.80 in Treatment G compared to 1.16 in Treatment B, and the percentage of best response profits was 87% for Treatment D and 91% in Treatment B. Neither of these are significant using a 1-sided Mann-Whitney test (p = 0.891) and (p = 0.842), respectfully. Again, these results suggest that second movers from Treatment D do not choose quantities that are closer the best response that Treatment B. Hence, the data fails to support H2.

Recall that the Cournot outcome is $q_a = q_b = 8$ and the profits to each firm are 64. At all $q_a > 8$ the best response by the second mover would yield unequal payoffs in favor of the first mover, and $q_a > 8$ could be viewed as an unkind action that may invoke possible negative reciprocity by the second mover. Conversely, at all $q_a < 8$ the best response would yield unequal payoffs in favor of the second movers, and $q_a < 8$ could be viewed as a kind actions that may invoke positive reciprocity by the second mover. To allow for the possibility that second mover have different sensitivities to positive/negative inequality and positive/negative reciprocity, we look at second mover response data in each of these two cases separately. Table 3 *Panel B* displays only the data for second movers who's corresponding first mover chose $q_a \leq 8$, and *Panel D* displays only the data for second movers who's corresponding first mover chose $q_a > 8$.

Table 3: Second Movers (SM) Response Data: All Treatments

Panel A: All Second Movers

	Treatment B	Treatment G	Treatment D
BR Rate	12/25 (48%)	10/23 (43%)	10/25 (40%)
Abs Dev from BR	1.16	1.30	1.80
% of BR profits	91%	92%	87%

Panel B: Conditional on $q_a \leq 8$

	Treatment B	Treatment G	Treatment D
BR Rate	4/8 (50%)	7/15 (47%)	5/9 (56%)
Abs Dev from BR	0.86	1.10	1.00
% of BR profits	97%	96%	97%

Panel D: Conditional on $q_a > 8$

	Treatment B	Treatment G	Treatment D
BR Rate	7/16 (43%)	3/8 (38%)	5/16 (31%)
Abs Dev from BR	1.36	1.75	2.25
% of BR Profits	88%	87%	82%

Notes: BR Rate was tested using a Fisher's Exact test and Abs Dev from BR and % of BR Profits were tested using a Mann-Whitney U-test. All tests were in relation to Treatment B.

Looking at the conditional second mover data, we see that across all treatments second movers tend to best respond less, choose quantities further away from the best response, and earn a lower percentage of BR profits when $q_a > 8$ compared to when $q_a \leq 8$. This would be consistent with the idea that agents have stronger sensitivities to disadvantageous inequality (Fehr and Schmidt 1999) and negative reciprocity

(Charness and Rabin 2002; Dufwenberg, Smith, and Van Essen *forthcoming*). However, when we compare second mover response data between the treatments, there are no significant differences between Treatments G and Treatment B, or Treatment D and Treatment B, regardless of whether $q_a \leq 8$ or $q_a > 8$.

4.2 First Mover Data

We proceed by presenting the aggregate first mover data and corresponding test of H3. Recall, H3 stated that first mover output levels in Treatment G will be closer to $\widehat{q}_a$ than in Treatment B, where $\widehat{q}_a$ was the optimal first mover quantity *given* the empirical response of second movers. To estimate the empirical response – $\widehat{q}_b(q_a)$, we simply regress the observed second mover's response quantity on the first movers quantity and a constant, i.e., $\widehat{q}_b(q_a) = \beta_0 + \beta_1 q_a$ We then calculate $\widehat{q}_a$ as the profit maximizing q_a given $\widehat{q}_b(q_a)$. Table 4 reports the estimate of $\widehat{q}_b(q_a)$ and the corresponding $\widehat{q}_a$ for each treatment.

Table 4: Empirical Response Function of Second Movers

	Treatment B	Treatment G	Treatment D
Response Function	$\widehat{q}_b = 9.67 - .17q_a$	$\widehat{q}_b = 6.22 + .25q_a$	$\widehat{q}_b = 10.01 - .11q_a$
$\widehat{q}_a \mid \widehat{q}_b(q_a)$	7.83	7.90	7.41

Choosing a first mover quantity of $q_a = 12$ is only optimal if second movers choose the profit maximizing best response. In our Stackelberg , the theoretical best response function is $q_b^{BR}(q_a) = 12 - .5q_a$. However, from Table 4, we can see that $\widehat{q}_b(q_a) \neq q_b^{BR}(q_a)$. Specifically, we can reject the null hypotheses that $\beta_0 = 12$ and $\beta_1 = -.5$ at the 1% level for each of the three treatments. As a result, choosing $q_a = 12$ is not optimal *given* $\widehat{q}_b(q_a)$. Table 4 reveals that choosing $\widehat{q}_a = 7.83$ and $\widehat{q}_a = 7.90$ is optimal for first movers given $\widehat{q}_b(q_a)$ in Treatment B and Treatment G, respectfully. To test H3, we compare the absolute deviation from the optimal first movers quantity choice – $\widehat{q}_a$. Table 5 presents the average first mover quantity and the absolute deviation from $\widehat{q}_a$ for each of the three treatments.

From Table 5, we can see that the average first mover output in Treatment G is 8.13 compared to 9.88 in Treatment B, which is significant at the 1% level using a Mann-Whitney U-test (p = 0.002). Additionally, the absolute deviation from $\widehat{q}_a$ is 1.45 in Treatment G compared to 2.41 in Treatment B. This difference is significant at the 1% level using a Mann-Whitney Test (p = 0.004). Thus, the data provides support for H3, namely, first movers in Treatment G choose output levels that are closer to the profit maximizing output level, relative to first movers in Treatment B.

TABLE 5: FIRST MOVERS (FM) OUTPUT DATA: ALL TREATMENTS

	Treatment B	Treatment G	Treatment D
Avg Output – q_a	9.88	8.13***	9.04*
$\widehat{q}_a \mid \widehat{q}_b$	7.83	7.90	7.41
Abs Dev from $\widehat{q}_a$	2.41	1.45***	1.95

Notes: Avg Output and Abs Dev from $\widehat{q}_a$ were tested using a Mann-Whitney U-test, in relation to Treatment B
***denotes significance at the 1% level *denotes significance at the 10% level

5 Conclusion

The previous experimental tests of the Stackelberg duopoly model have found little support for the theoretical predictions of the model (HMN and HW). We hypothesize that the theoretically inconsistent results from HMN and HW are a result of systematic difference between lab environments and naturally occurring firm environments. These environmental differences may limit the generalizability of the lab results to firms in the field. The motivation of the study is twofold. First, this study experimentally investigates how group decision making influences behavior in an experimental Stackelberg game. Specifically, do groups behave more in line with the theoretical predictions of the model compared to individuals. Second, this study experimentally investigates whether a deliberation period leads second mover to make decisions that are more in line with the predicted profit maximizing best response. We argue that group decision making units and deliberation periods are both representative of decision-making units in the field, hence, our motivation to investigate their impact on decision making in an experimental Stackelberg duopoly in the lab.

In relation to the influence of group decision making, the data reveals very little difference in the decision making of second movers between individuals and 2-person groups. Specifically, both group and individual second movers exhibit behavior that is inconsistent with profit maximizing best response. However, group first movers choose output levels that are significantly lower than individual first movers. Initially, one might think that this pattern in the data reveals that group first movers are exhibiting behavior that in more inconsistent with profit maximization. However, after conditioning on the empirical non best response of second movers, the data reveals that the chosen output levels of group first movers are significantly *closer* to the predicted profit maximizing quantity than individual first movers.

Note, group first movers choosing quantity levels that are lower than the predicted Stackelberg leader quantity ($q_a = 12$) is consistent with the idea that group first movers collectively correctly anticipated the non best response of second movers and, consequently, maximized profits by choosing lower quantity levels, relative to individual first movers. However, an alternative explanation is that group first movers where simply exhibiting more cooperative behavior, which would also correspond to choosing lower quantities. Groups exhibiting more cooperative behavior would be consistent with the findings of Cason and Mui (1997), and what they refer to as the "Social Comparison Theory" (SCT). The idea is that group members want to be perceived in a socially desirable way by other group members and, as a result, group decision making is more cooperative. However, this is contrast with the "social support of self-interested competitiveness" and the "schema-based distrust" hypotheses that predict more competitive behavior by groups. Given the body of experimental literature (discussed in Section 2) that finds more competitive behavior by groups, we are inclined to think that the former is a more plausible explanation, i.e., group first movers appear to exhibit behavior that is more consistent with rational profit maximization.

In relation to deliberation periods, the data reveals that a 10-minute deliberation period did not lead to significantly different second mover decisions, relative to when there was no deliberation period. In particular, second movers with and without a deliberation period exhibited behavior that was inconsistent with the predicted profit maximizing best response. Additionally, second movers that had the 10-minute deliberation period actually choose responses that are *further* from the best response. Although these differences were not significant at standard levels, this suggests that the deliberation period may have actually acted as more of a "heating-up" period for harboring emotions, and not "cooling-off" period for emotions, as originally hypothesized.

We acknowledge that the observed lack of effectiveness of the deliberation period, in the sense that it did not lead to more rational profit maximizing best responses, may be a by-product of the chosen length of the deliberation period, 10 minutes. However, Grimm and Mengel (2011) found evidence that a 10-minute deliberation period was effective at cooling-off emotions. Additionally, to the best of our knowledge, the literature related to deliberation period does not postulate any formal model linking the length of the deliberation period and its effectiveness at cooling-off emotions. Thus, there is no reason to suspect, a priori, that a longer deliberation period would produce different results. Additionally, using a longer deliberation period, e.g. 24-hours, would be cumbersome and impractical to implement in a lab, thus undermining one of our motivations to use a 10-minute deliberation period. Certainly, future research that investigates the effectiveness of deliberations periods, with respect to duration and the context of the decision making environment, is warranted.

By investigating the impact of group decision making and deliberations periods in a Stackelberg game, this study contributes to the mature body of literature on group decision making and growing body of literature on deliberation periods. Overall, we find that group first movers in the Stackelberg game exhibit decision making that is more consistent with rational profit maximization, which suggests that group decision making might foster collective critical thought in games. Whereas, we find that group second movers exhibit decision making similar to individuals, which suggests that groups decision making might not be effective at mitigating the influence of non-selfish motivations. Additionally, a 10-minute deliberation period did not result in second mover decisions that were more consistent with selfish profit maximization. As a broader methodological contribution, the results of this study can provide insights regarding the design of future experiments relating to models of firm decision making. In particular, when testing models that are strategically more complex, implementing group decision making in the lab might result in behavior that is more consistent with profit maximization. However, when testing models where social preferences and emotional motivations are likely to be salient, group decision making and *short* deliberation periods might have little effect on behavior in the lab.

6 Appendix

6.1 Player Instructions - Baseline Treatment[13]

PLAYER INSTRUCTIONS

Welcome to our experiments! Please read these instructions carefully! Do not talk to your neighbors and please remain quiet during the entire experiment. Raise your hand if you have a question. We will answer them privately. In our experiment, you can earn different amounts of money, depending on your decisions and the decision of the other participants who are matched with you.

You play the role of a firm which produces the same product as another firm in the market. Both firms always have to make a single decision, namely the amount of output they want to produce in this market. The profit to each firm will depend on the level of output chosen by each of the firms. In the table on the other sheet that is given to you, you can see the profits of each firm for all possible output combinations of the two firms. The table reads as follows: the header of the row represents one firm's output decision (Firm-A) and the header of the column represents the output decision of the other firm (Firm-B). Inside the little box where row and column intersect, Firm-A's profit corresponding to this combination of outputs is the number to the left. Firm-B's profit corresponding to this combination of outputs is the number to the right. The profit is denoted in a fictitious unit of money which we call Taler. Before the experiment begins, you will have a few minutes to look over the payoff table. You will then be asked two control questions about the matrix to ensure your understanding of it.

You have been randomly assigned either the role of Firm-A or Firm-B, and randomly matched to another participant of the opposite role. After the two control questions, your Firm role will be revealed to you. The experiment will proceed in three stages.

Stage 1: Firm-A will begin by choosing an output level to produce. Firm-A's output level will then be revealed to Firm-B.

Stage 2: Firm-B will then respond by choosing an output level to produce.

Stage 3: The output decisions of both Firms and the corresponding profits of each Firm will be displayed to both Firms. You will then be asked to complete a simple questionnaire that will take approximately 10 minutes to complete.

[13] The instructions for the Group Treatment were essentially identical to the Baseline Treatment. Except, subjects were informed that they, along with another subject, comprise a two person group that will be playing the role of a firm.

After all three stages are complete; you will be privately paid your experimental earnings. Your profit in Talers from the decision task will be converted to $ at a rate of 10-1. That is, every 10 Talers correspond to $1 USD. In addition to your profit, you will receive a $3 USD show-up payment for participating in the experiment. All decisions and answers to the questionnaire will be kept anonymous among the participants and the experimenters.

6.2 Player Instructions - Cooling-off Treatment

PLAYER INSTRUCTIONS

Welcome to our experiments! Please read these instructions carefully! Do not talk to your neighbors and please remain quiet during the entire experiment. Raise your hand if you have a question. We will answer them privately. In our experiment, you can earn different amounts of money, depending on your decisions and the decision of the other participants who are matched with you.

You play the role of a firm which produces the same product as another firm in the market. Both firms always have to make a single decision, namely the amount of output they want to produce in this market. The profit to each firm will depend on the level of output chosen by each of the firms. In the table on the other sheet that is given to you, you can see the profits of each firm for all possible output combinations of the two firms. The table reads as follows: the header of the row represents one firm's output decision (Firm-A) and the header of the column represents the output decision of the other firm (Firm-B). Inside the little box where row and column intersect, Firm-A's profit corresponding to this combination of outputs is the number to the left. Firm-B's profit corresponding to this combination of outputs is the number to the right. The profit is denoted in a fictitious unit of money which we call Taler. Before the experiment begins, you will have a few minutes to look over the payoff table. You will then be asked two control questions about the matrix to ensure your understanding of it.

You have been randomly assigned either the role of Firm-A or Firm-B, and randomly matched to another participant of the opposite role. After the two control questions, your Firm role will be revealed to you. The experiment will proceed in three stages.

Stage 1: Firm-A will begin by choosing an output level to produce. Firm-A's output level will then be revealed to Firm-B.

Stage 2: Both Firms will then be asked to complete a simple questionnaire that will take approximately 10 minutes to complete.

Stage 3: After the questionnaire, Firm-B will then respond by choosing an output level to produce. Then output decisions of both Firms and the corresponding profits of each Firm will be displayed to both Firms.

After all three stages are complete; you will be privately paid your experimental earnings. Your profit in Talers from the decision task will be converted to $ at a rate of 10-1. That is, every 10 Talers correspond to $1 USD. In addition to your profit, you will receive a $3 USD show-up payment for participating in the experiment. All decisions and answers to the questionnaire will be kept anonymous among the participants and the experimenters.

6.3 Questionnaire

1. What is your gender?
2. How old are you?
3. What is your class level?
4. What is your major?
5. What is your approximate GPA?
6. Have you ever taken an economics course?
7. Are you currently employed?
8. Is your current job in a business related industry?
9. How many total years of work experience do you have?
10. Have you ever participated in an experiment?
11. How did you hear about the Economic Science Lab?
12. Have you ever referred a friend to the Economic Science Lab?
13. Is English your first language?
14. Are you an Arizona resident?
15. Are you currently carrying more than $10 in cash?
16. Suppose a bat and a ball cost a total of $1.10, and the bat cost $1.00 more than the ball. How much does the ball cost? (Frederick 2005; CRT #1)
17. Suppose it takes 5 machines 5 minutes to make 5 gadgets. How many minutes does it take for 100 machines to make 100 gadgets? (Frederick 2005; CRT #2)
18. In a lake, there is a patch of lillypads. Everyday the patch doubles in size. It takes 48 days for the patch to cover the entire lake. How many days does it take to cover 1/2 of the lake? (Frederick 2005; CRT #3)

References

[1] Adler, R., Rosen. B., & Silverstein, E. (1998). "Emotions in Negotiation: How To Manage Fear and Anger." Negotiation Journal 14, 161-179.

[2] Bornstein, G., Kugler, T. & Ziegelmeyer, A. (2004). "Individual and group decisions in the centipede game: are groups more 'rational' players?" Journal of Experimental Social Psychology 40, 599-605.

[3] Bornstein, G. & Yaniv, I. (1998). "Individual and group behavior in the ultimatum game: are groups more 'rational' players?" Experimental Economics 1, 101-108.

[4] Brown, R. (1954). Mass phenomena. In G. Lindzey (Ed.), Handbook of Social Psychology, pp. 833-876. Cambridge, MA: Addison- Wesley.

[5] Campbell, D. T., & Stanley J.C. (1963). Experimental and Quasi-Experimental Designs for Research. Boston: Houghton Mifflin.

[6] Cason, T. & Mui, V. (1997). "A laboratory study of group polarization in the team dictator game." Economic Journal 107, 1465-1483.

[7] Charness, G., & Rabin, M. (2002). "Understanding Social Preferences with Simple Tests." The Quarterly Journal of Economics 117, 817-869.

[8] Cooper, D. & Kagel, J. (2005). "Are two heads better than one? Team versus individual play in signaling games." American Economic Review 95, 477-509.

[9] Cox, J. (2002). "Trust, reciprocity, and other-regarding preferences: groups vs. individuals and males vs. females." In R. Zwick & A. Rapoport (Eds.), Advances in experimental business research, pp. 331-350. Dordrecht: Kluwer Academic Publishers.

[10] Cox, J., and Hayne, S. (2006). "Barking up the Right Tree: Are Small Groups Rational Agents?" Experimental Economics 3, 209-222.

[11] Dufwenberg, M. & Kirchsteiger, G. (2004). "A Theory of Sequential Reciprocity." Games and Economic Behavior 47, 268-298.

[12] Dufwenberg, M., Smith, A., & Van Essen, M. (forthcoming). "Hold-up: With a Vengeance." Economic Inquiry.

[13] Falk, A., Heckman, J. (2009). "Lab Experiments are a Major Source of Knowledge in the Social Sciences." Science 326, 535-538.

[14] Fehr, E. & Schmidt, K. (1999). "A Theory of Fairness, Competition, and Cooperation." The Quarterly Journal of Economics 114, 817-868.

[15] Fischbacher, U. (2007). "z-Tree, Toolbox for Readymade Economic Experiments." Experimental Economics 10, 171-178.

[16] Fonseca, M., Huck, S. & Normann, H. (2005). "Playing Cournot Although Shouldn't: Endogenous Timing in Experimental Duopolies with Asymmetric Costs." Economic Theory 25, 669-677.

[17] Fonseca, M., Muller, W. & Normann, H. (2006). "Endogenous Timing in Duopoly: Experimental Evidence." International Journal of Game Theory 34, 443-456.

[18] Frederick, S. (2005). "Cognitive Reflection and Decision Making." Journal of Economic Perspectives 19, 25-42.

[19] Friedman, D., & Sunder, S. (1994). "Experimental Methods: A Primer for Economists." Cambridge University Press.

[20] Gneezy, U., & List, J. (2006). "Putting Behavioral Economics to Work: Testing for Gift Exchange in Labor Markets Using Field Experiments." Econometrica 74, 1365-1384.

[21] Goleman, D. (1995). Emotional intelligence. New York: Bantam Books.

[22] Grimm, V., & Mengel, F. (2011). "Let Me Sleep on it: Delay Reduces Rejection Rates in Ultimatum Games." Economic Letters 111, 113-115.

[23] Hamilton, J. & Slutsky, S. (1990). "Endogenous Timing in Duopoly Games: Stackelberg or Cournot Equilibria." Games and Economic Behavior 2, 29-46.

[24] Harrison, G. & List, J. (2004). "Field Experiments." Journal of Economic Literature 42, 1009-1055.

[25] Huck, S., Muller, W. & Normann, H. (2001). "Stackelberg Beats Cournot: On Collusion and Efficiency in Experimental Markets." The Economic Journal 111, 749-765.

[26] Huck, S., Muller, W. & Normann, H. (2002). "To Commit or Not to Commit: Endogenous Timing in Experimental Duopoly Markets." Games and Economic Behavior 38, 240-264.

[27] Huck, S. & Wallace, B. (2002). "Reciprocal Strategies and Aspiration Levels in a Cournot-Stackelberg Experiment." Economics Bulletin 3, 1-7.

[28] Insko, C., & Schopler, J. (1987). Categorization, competition and collectivity. In C. Hendrick (Ed.), Group processes. Vol. 8, pp. 213-251. New York: Sage.

[29] Insko, C., Hoyle, R., Pinkley, R., Hong, G., Slim, R., Dalton, G., Lin, Y., Ruffin, P., Dardis, G., Berthal, P., & Schopler, J. (1988). "Individual-group discontinuity: The role of a consensus rule." Journal of Experimental Social Psychology 24, 505-19.

[30] Insko, C. A., Schopler, J., Hoyle, R., Dardis, G., & Graetz, K. (1990). "Individual-group discontinuity as a function of fear and greed." Journal of Personality and Social Psychology 58, 68-79.

[31] Insko, C., Schopler, J., Graetz, K., Drigotas, S., Currey, D., Smith, S., Brazil, D., & Bornstein, G. (1994). "Interindividual-Intergroup Discontinuity in Prisoner's Dilemma Game." The Journal of Conflict Resolution 38, 87-116.

[32] Kahneman, D. (2003). "Perspective on Judgment and Choice: Mapping Bounded Rationality." American Psychologist 58, 697-720.

[33] Kocher, M. G., & Sutter, M. (2005). "The decision maker matters: individual versus group behavior in experimental beauty-contest games." Economic Journal 115, 200–223.

[34] Kocher, M. G., & Sutter, M. (2007). "Individual versus group behavior and the role of the decision making procedure in gift-exchange experiments." Empirica 34, 63–88.

[35] Kugler, T., Bornstein, G., Kocher, M. G., & Sutter, M. (2007). "Trust between individuals and groups: groups are less trusting than individuals but just as trustworthy." Journal of Economic Psychology 28, 646-657.

[36] Lau, S. & Leung, F. (2006). "Non-Stackelberg Outcomes in Stackelberg Duopoly Experiments: A Parsimonious Explanation Based on Inequity Aversion." Working Paper.

[37] Levitt, S., & List, J. (2007). "What do Laboratory Experiments Measuring Social Preferences Reveal About the Real World." Journal of Economic Perspectives 21, 153-174.

[38] Loewenstein, G. (2000). "Emotions in Economic Theory and Economic Behavior." The American Economic Review 90, 426-432.

[39] Luhan, W., Kocher, M., & Sutter, M. (2009). "Group Polarization in the Team Dictator Game Reconsidered." Experimental Economics 12, 26-41.

[40] McCallum, D. M., Harring, K., Gilmore, R., Drenan, S., Chase, J., Insko, C. A., & Thibaut, J. (1985). "Competition Between Groups and Between Individuals." Journal of Experimental Social Psychology 21, 301-320.

[41] Messick, D., Moore, D., & Bazerman, M. (1997). “Ultimatum Bargaining with a Group: Underestimating the Importance of the Decision Rule.” Organizational Behavior and Human Decision Processes 69, 87-101.

[42] Normann, H-T., Ruffle, B. (2011). “Introduction to the Special Issue on Experiments in Industrial Organization.” International Journal of Industrial Organization 29, 1-3.

[43] Oechssler, J., Roider, A., & Schmitz, P. (2008). “Cooling-Off in Negotiations – Does it Work?” Working paper.

[44] Robert, C., & Carnevale, P. (1997). “Group Choice in Ultimatum Bargaining.” Organizational Behavior and Human Decision Processes 72, 256-279.

[45] Sanfey, A., Rilling, J., Aronson, J., Nystrom, L., & Cohen, J. (2003). “The Neural Basis of Economic Decision-Making in the Ultimatum Game.” Science 300, 1755-1758.

[46] Schopler, J., Insko, C., Graetz, K., Drigotas, S., & Smith, V. (1991). “The Generality of the Individual-group Discontinuity Effect: Variations in Positivity-negativity of Outcomes, Players’ Relative Power, and Magnitude of Outcomes.” Personality and Social Psychology Bulletin 17, 612-24.

[47] Schopler, J., Insko, C., Graetz, K., Drigotas, S., Smith, V., & Dahl, K. (1993). “Individual-group Discontinuity: Further Evidence for Mediation by Fear and Greed.” Personality and Social Psychology Bulletin 19, 419-31.

[48] Smith, V.L. (1982). “Microeconomic Systems as an Experimental Science.” The American Economic Review 72, pp. 923-955

[49] Sutter, M. (2005). “Are four heads better than two? An experimental beauty-contest game with teams of different size.” Economic Letters 88, 41-46.

[50] Wilde, L. (1981). “On the use of Laboratory Experiments in Economics.” In P. Joseph (Ed.), The Philosophy of Economics, pp. 137-143. Dordrecht: Reidel.