המכון למחקר כלכלי בישראל
על-שם מוריס פאלק בע"מ (חל"צ)
The Maurice Falk Institute for
Economic Research in Israel Ltd.

Groups, Group Members and Individuals: Choices and Impulses in Repeated Risky Decisions

by

Einav Hart, Déborah Marciano

and Eyal Winter

Discussion Paper No. 17.07

December 2017

בנין פרץ נפתלי, קמפוס האוניברסיטה העברית, הר הצופים, ירושלים 9190501
The Hebrew University Campus, MT. Scopus, 9190501 Jerusalem, Israel
www.falk.huji.ac.il

Groups, Group Members and Individuals: Choices and Impulses in Repeated Risky Decisions[1]

By

Einav Hart
University of Pennsylvania

Déborah Marciano
Hebrew University of Jerusalem

Eyal Winter
Hebrew University of Jerusalem

* E. Hart and D. Marciano contributed equally to this work.

Abstract

Voting groups such as judicial panels and committees make highly consequential and repeated decisions. Yet, we know very little about how groups take into account past successes and failures when making subsequent decisions. In two experiments, groups and individuals made repeated choices between two risky alternatives. Our main interest is the choice dynamics: We compare groups and individuals in terms of the evolution of choices over time, and what affects these changes. Experiment 1 compared voting groups of three non-communicating members whose majority determines the group decision, to individuals choosing by themselves. We found that groups did not outperform individuals. Groups, like individuals, based their choices on the outcome of the previous choice, and the counterfactual outcome. These effects were stronger for groups than for individuals. Experiment 2 demonstrated that reactivity to outcomes increased when individuals are responsible for others' outcomes, and that feedback regarding others' choices diminished reactivity. Our findings qualify the common intuition that groups are more levelheaded than individuals. Short term choice dynamics should be taken into account when entrusting decisions to groups rather than to individuals.

Keywords: group decision making; risky decisions; decisions from experience; reactions to outcomes

The Maurice Falk Institute for Economic Research in Israel Ltd.
Jerusalem, December 2017 • Discussion Paper No. 17.07

---

[1] We thank the German Israeli Foundation for financial support.
Eyal Winter is grateful for the financial support given by the Falk Institute
Correspondence should be addressed to: Einav Hart, Philosophy, Politics and Economics (PPE) program, Claudia Cohen hall, University of Pennsylvania, Philadelphia, PA 19104, Phone: +972-2-6586060, Fax: +972-2-6513681, e-mail: einavi@gmail.com

Introduction

Groups are ubiquitous in most societies and cultures, from families to board members, classes to government. Many influential decisions are allocated to groups: parliaments vote on which bills to pass, judicial panels decide on convictions and appeals, and FDA committees vote on drug approvals. Groups' advantages over individuals are often touted; in many situations more heads are better than one – such as in situations that require more knowledge or memory capacity. Groups also have critical disadvantages over individuals, such as polarization, heightened conformism, and inability to agree. Yet, previous literature has mostly neglected the evolution of groups' decisions over time. We know very little about how groups learn from their experiences and how they take into account the outcomes of their previous choices. Here we fill this critical gap, examining how groups react to their previous successes and failures when making future choices. The purpose of our study is to compare groups and individuals in terms of the learning dynamics through the decision making process.

Choice dynamics are crucial in the comparison between groups and individuals, beyond the comparison of performance. Short term dynamic patterns may impinge on a variety of organizational questions, such as whether groups are more or less likely to innovate than individuals; whether groups are more or less likely to depart from a failing strategy than individuals; and whether policies determined by committees are expected to adhere longer or shorter than ones decided by individual executives. Our study provides insights to these questions.

We investigate how the knowledge that one belongs to a group affects one’s choices and especially choice dynamics over time. Notably, social processes that may occur within groups, such as discussion and deliberation, add several layers of complexity and prevent concrete conclusions about the differences between group and individual decision making.

Therefore, as a first step in studying choice dynamics we examine decisions made by non-communicating, non-deliberating, groups (or "non-cooperative groups", Bornstein, 2008; "individualistic groups", Blinder, 2007; "nominal groups", Taylor, Berry, & Block, 1958). Group members vote or decide individually and the decision is an aggregate of these individual decisions; that is, the decision is not reached collectively, by a joint process, but rather is a function of the individual decisions. We henceforth refer to such groups as "voting groups". In what follows, we describe two contrasting hypotheses regarding groups' choice dynamics and its comparison with that of individuals. Our two experiments use a simple repeated risky decision making task to test these hypotheses and explore accountability and availability of information as potential mechanisms.

Group versus individual choice dynamics Individuals' choices, and their likelihood of repeating a previous choice or switching from it, depend on previous outcomes (Avrahami & Kareev, 2011; Camerer & Ho, 1999; Erev et al., 2010; Hart et al., 2016; Hertwig et al., 2004; Kareev, Avrahami & Fiedler, 2014; Lejarraga, Dutt, & Gonzalez, 2012; Nowak & Sigmund, 1993; Selten, Abbink, & Cox, 2005). Individuals react both to the received payoff from their chosen alternative, and (often even more strongly) to the forgone, counterfactual, payoffs: People tend to switch to the alternative that would have yielded a better outcome (Avrahami & Kareev, 2011; Erev & Barron, 2005; Ert & Erev, 2007; Hart et al., 2016; Kareev et al., 2014; Mellers, Schwartz, & Ritov, 1999; Yechiam & Busemeyer, 2005; 2006; Yechiam & Rakow, 2011). Yet, the influence of outcomes on choice dynamics is consequential and yet mostly unknown when *groups* are those who make the decisions.

Groups as decision units, and the comprising group members, may react differently than individuals to their previous choices and outcomes. Potentially, the mere aggregation of individual members' choices leads to an observed shift in reactivity of groups, compared to individuals (Ambrus et al., 2015). More interesting predictions arise from Social Comparison

Theory (e.g., Levinger & Schneider, 1969; Vroom et al., 1969). According to this theory, people behave fundamentally differently when they are part of a group compared to when they are by themselves: "When one moves from a social to a nonsocial setting [...] the individual products available for combination may differ" (Vroom et al., 1969).

Hypothesis 1a: Group members will be less reactive to their outcome than individuals.

Hypothesis 1b: As a product of their members' behavior, groups as decision units will be less reactive than individuals.

Hypothesis 1c: Group members will be less reactive to the outcome when more group members made the same choice.

Within group decisions, each member has only a part in the decision – compared to an individual choice, which is always implemented. Group members might thus feel that they are not to be blamed for a bad outcome (or praised for a good one), and might experience diffusion of responsibility (Latane, Williams, & Harkins, 1979; Wallach, Kogan, & Bem, 1964). Less control over outcomes has been associated with lower overall responsiveness in both humans and animals (Li et al., 2010; Seligman, 1975) and with social loafing in social decision contexts, (Karau & Williams, 1993; Latane et al., 1979).

Groups' and individuals' *differential use of information* also supports the conjecture that groups would be less likely than individuals to be swayed by the most recent outcomes. Groups are able to gather and process more information (Cohen & Thompson, 2011; Charness & Sutter, 2012), and use it better than individuals (Hinsz, Tindale, & Vollrath, 1997). Groups tend to rely more than individuals on memory, and have a longer memory span (Cohen & Thompson, 2011; Charness & Sutter, 2012; Hinsz, Tindale, & Vollrath, 1997). Lejarraga et al. (2014) find that groups make better choices than do individuals initially, but adapt more slowly to a change in the lotteries' properties.

Two other mechanisms that could lead to group members' lower reactivity are *social information and conformity*. One might treat other group members' choices as sources of information (Bettenhausen & Murnighan 1985). Even when there is no additional objective information, group members may attempt to conform to others. Both will lead group members to place more weight on others' decisions than on the obtained outcome when making their decisions (Asch, 1956; Janis, 1972; 1982). To see why this would lead to lower reactivity, consider the following example. If one's choice yielded a bad outcome, one may think that the choice was wrong (i.e., that one chose the worse alternative), or that one chose correctly (i.e., the typically better alternative) but was unlucky. One may be more likely to attribute the bad outcome to bad luck rather than to a bad decision if one is in a group and sees that other members chose the same alternative. Thus, group members within a majority may be more likely to ignore the previous outcome, and more likely to repeat their previous choice, than individuals.

Hypothesis 2a: Group members will react more strongly to their outcomes than individuals.

Hypothesis 2b: As a product of their members' behavior, groups as decision units will be more reactive than will individuals.

Hypothesis 2c: Group members who were pivotal in the choice will react more strongly to its outcome.

One may derive a diametrically opposite argument to those presented above from Social Comparison Theory. The presence of others motivates people to present themselves in a socially desirable way (Levinger & Schneider, 1969). While reactivity to outcomes per se is neither socially desirable nor undesirable (see the General Discussion for more on this issue), group members might feel more accountable than individuals for their choices and outcomes (for reviews, see Guerin, 1986; Lerner & Tetlock, 1999). A group member's decision affects

not only his or her outcome, but also that of the other members (if he or she was in the majority). People who feel accountable are more sensitive to risk and losses (Tetlock & Boettger, 1994), pay more attention to, and use, situational cues (relevant or irrelevant for the decision; Lerner & Tetlock, 1999). Individuals who were observed had increased neural responses associated with outcome evaluation (Tian et al., 2015). In addition, group members may perceive the stakes as higher (even if the personal outcome is identical to that of the individual). With these higher stakes, reactivity to the outcome may be stronger. Thus, group members might experience – and react to – gains and losses more strongly than individuals.

A group member's feeling of responsibility, and in turn, reactivity to outcomes, may be intensified when that member was pivotal in the decision; namely, when one could have reversed the entire decision (Lagnado, Gerstenberg, & Zultan, 2013). In such situations, the counterfactual – the forgone payoff yielded by the unchosen option – is more salient and may lead to a stronger affective reaction and to a stronger behavioral response (Kahneman & Tversky, 1982). Essentially, when one is the vote tipping the scale, the outcome should play a bigger role in determining one's subsequent decision.

Study Overview

In two experiments, we investigate how groups react to their previous outcomes when making their subsequent choice, and how different elements of the social context affect these reactions. We use a simple repeated choice paradigm (similar to Avrhami & Kareev, 2011; Lejarraga et al, 2014), in which individuals and groups make multiple choices over time between two lotteries, and see the outcomes of both chosen and unchosen lotteries. Individuals and groups chose repeatedly between two gambles or "boxes". Each had a specific probability of a coin (unknown to participants) – one better (higher) than the other. In Experiment 1, we compare voting groups' and individuals' choice dynamics – the reactions to the previous outcomes. We contrast Hypotheses 1 and 2 by examining choice dynamics at the

"unit" level, namely groups versus individuals (Hypotheses 1a and 2a), and at the individual level, namely differences in individual behavior between group members and individuals choosing for themselves only (Hypotheses 1b-c and 2b-c). To follow previous studies, we also examine the overall choice rate of the better box. Experiment 2 extends the results of Experiment 1, by examining the roles of responsibility for others' outcomes, and feedback regarding others' decisions in choice behavior as underlying mechanisms.

We define reactions to outcomes as immediate, short-lived, persistent changes in behavior corresponding to the most recent outcome of one's decision, in line with Avrahami and Kareev (2011). Our paradigm allows us to test the weight decision makers give to both their received and forgone outcomes. As decision makers observe both alternatives' outcomes, this setup prevents confounding of switching between lotteries with explorative behavior such as that evinced by Hertwig and Erev (2009) among others.

We study voting groups, in which each group member votes individually and anonymously, and the majority of votes determines the final decision. Voting groups enable us to more directly and clearly examine how *belonging to a group* – as a social context – affects individual group members' behavior; that is, how group membership modifies the individual decisions. We choose to study voting groups –rather than communicating groups or large crowds– as voting groups allow us to make comparisons between group members and individuals, and ascertain the influence of being part of a group on overall choice and its temporal dynamics. We note that the potential group membership effect is thus separate from social factors such as shyness and desire to express expertise (e.g., Ambrus, Greiner, & Pathak, 2015; Charness, Karni, & Levin, 2006; Diehl & Stroebe, 1987; Kerr & Tindale, 2004; Steiner, 1972), and effects of the deliberation process itself (Baron, 1986; Briley & Wyer, 2002; Sunstein, 2006; Vroom, Grant, & Cotton, 1969; Zajonc, 1965), such as polarization (Isenberg, 1986; Moscovici & Zavalloni, 1969) or groupthink (Janis, 1972; 1982). While

members in voting groups are less distracted (or not at all) by the aforementioned social considerations, they are still aware of the other group members, in contrast to studies regarding the wisdom of crowds. In such crowds, there is no co-dependence: One's decisions do not affect others' choices or outcomes, nor are one's own choices and outcomes affected by those of other members of the crowd. Further, the choices and judgments made by these groups or crowds do not affect the outcome of the group as a whole. In contrast, in voting groups such as committees, boards, and even countries, belonging to a group may indeed affect one's choice, and – as long as one is in the majority – one's choice affects everyone's outcome, including one's own.

Another important feature of our design is that groups have a fixed make-up over time, that is, comprise of the same members for the duration of the experiment. Fixed groups are a necessity in our setup, as we investigate the choice dynamics of groups as *decision making units*. Only in this way, we can examine how the group choice and outcome affects the *same group*'s consecutive choice.

Experiment 1

Method

Eighty-four Hebrew University students participated in the experiment, in exchange for monetary compensation based on their decisions. Subjects played a computerized task, making repeated choices between two boxes over 100 rounds. Subjects knew that each of the boxes had a fixed probability of containing a coin, and that the presence of a coin was determined independently for each box. At the end of each round, the two boxes opened, and their contents revealed. Subjects received the payoff (coin or no coin) in the chosen box; the payoffs accumulated and converted to money at the end of the experiment.

We did *not* inform subjects that one box had a 60% chance of containing a coin, while the other had a 40% chance. Subjects experienced the probabilities over time; these were not

explicitly stated. The position of the better box (left or right) was counterbalanced between sessions.

Choices were made either by an individual subject (SLF condition; n=24), or by a fixed group of three subjects, randomly matched at the beginning of the experiment (GRP condition; n=60, constituting 20 groups).[2] In the GRP condition, we told subjects they are randomly grouped with two other subjects in the session; they did not know the identity of the other members, but knew that the group composition would be the same throughout the experiment. Subjects could not communicate with each other.

In the GRP condition, the group choice was determined via a majority rule: After each subject made a choice, the box that got the most votes was chosen for the entire group. In this condition, subjects received feedback regarding their own choice, how many group members chose each box, and the box chosen by the majority – which entailed their payoff.

The payoff rule in the GRP condition was equivalent to that in the SLF condition: Each coin in the chosen box added a point to each subject's till. Every two coins were worth one New Israeli Shekel (approximately $0.27). On average, subjects earned 27.25 NIS. There was no difference in subjects' payoffs in the two conditions (SLF: M=27.04, SD= 3.10; GRP: M=27.43, SD=2.12; t(82)=0.651, p=.517).

Results

Groups perform no better than individuals

We first look at decision units' aggregate performance, taking each group in the GRP condition and each individual in the SLF condition, as a unit. There were thus 44 decision units in total. Both groups and individuals, as units, were able to discern the better box: On average, the better box was chosen on 72.61% of the rounds (SD=0.194); this proportion was significantly higher than chance (t(43)=7.744, p<.001).

[2] Lejarraga et al. (2014) studied similar numbers of individuals and groups.

As can be seen in Figure 1(a), the frequency of choosing the better box increased over time, but was mostly stable after the first few rounds. We conducted a logistic regression with variance clustered by decision unit (controlling for the repeated choices; n=8400 data points, 44 units).[3] We used GRP/SLF condition and round (as a logarithmic function) as independent variables. The frequency of choosing the better box indeed increased with round (OR=1.555, z=6.43, p<.001). There was no difference between groups and individuals in choosing the better box (SLF: M=0.724, SD=0.447; GRP: M=0.729, SD=0.445; OR=1.423, z=0.79, p=.430), nor a difference over time between groups and individuals (OR=0.911, z=-0.67, p=.500). The location of the better box (right or left) did not affect choice frequency (t(42)=0.06, p=.954).

Individuals within groups learn more slowly

We next turn to the choice behavior of individuals in GRP and SLF. Each individual – each person in SLF and each group member in GRP – constituted an analyses unit. We conducted a logistic regression with variance clustered by individual (n=8400 data points, 84 clusters) on better box choices, with condition and round (as a logarithmic function) as independent variables. As with decision units, individuals' frequency of choosing the better box increased with round (OR=1.422, z=5.87, p<.001), but mostly in the earlier rounds. There was no difference between individuals in GRP and SLF in the frequency of choosing the better box (OR=1.920, z=1.76, p=.078). Yet, as Figure 1(b) shows, there was a significant difference between conditions in the pattern over time: Choice rates of individuals in GRP changed less over time, compared to individuals in SLF (OR=0.762, z=-2.27, p=.023). That is, individuals in groups seemed to learn more slowly than individuals who chose for themselves only.

Groups react more than individuals to their most recent outcome

[3] As participants made multiple decisions, there may be a correlation within unit. We correct for this correlation by clustering the standard errors by unit (Petersen, 2009; Williams, 2000).

In order to examine whether, and how, units react to the outcome of their previous choice, we calculated a binary "switch" variable reflecting whether the current choice was different from its predecessor. A logistic regression model, clustered by unit, examined whether switch tendency was affected by the previous choice (whether the better box was chosen), the payoffs in both boxes, and the GRP/SLF condition. There were less switches following a choice of the better box (OR=0.273, z=-6.18, p<.001), which might be accounted for by the different choice rates of the better and worse boxes. When the chosen box did not contain a coin, units tended to switch (OR=0.673, z=-2.51, p=.012). Further, when the unchosen box contained a coin, units tended to subsequently switch to it (OR=1.440, z=3.86, p<.001). This effect was moderated when the chosen box contained a coin: When a unit received a coin, the unit was less sensitive to the content of the unchosen box (OR=0.705, z=-3.59, p<.001).

Our main objective was to test whether groups demonstrate the same reactions to payoffs as individuals. Both groups and individuals tended to switch at about the same rate (OR=1.196, z=0.69, p=.493). However, groups were more sensitive to payoffs than individuals: When the chosen box did not contain a coin, groups switched more often than individuals (OR=0.638, z=-2.93, p=.003).[4] The GRP and SLF switch tendencies following all outcome combinations are shown in Figure 2.

These results were not only due to "rational" switches from the worse to the better box. We observed the same effects when analyzing switches only after choosing the better box, with the exception that the outcome of the unchosen box was was now only marginally significant. Moreover, the results held even when analyzing only units for which the *observed* probability of a coin in the previous rounds was substantially higher (10%) in the better box than the worse box; that is, units that (very likely) know which box is the better box.

[4] Interestingly, when conducting regressions by condition, the main effects of the chosen and unchosen boxes' outcomes were significant only in the GRP condition, and not in the SLF condition. Notably, the interaction between the chosen and unchosen boxes' outcomes was highly significant in both conditions.

As we noted in our hypotheses section, the heightened reactivity of groups compared to individuals might be a mere statistical result of the aggregation of individual tendencies – the same tendencies observed for individuals choosing only for themselves. However, our data show that this is not the case: The individual tendencies themselves differed when the individual belonged to a group, as the next section shows.

Forces at play within groups

We next turn to the choice behavior of individuals in GRP and SLF to further understand units' decisions – to test whether group members and individuals choosing only for themselves have similar reactions to their outcomes.

As groups were composed of three members, each group decision could be made unanimously by the three members, or by a majority of two (with one member outvoted). Of all GRP decisions, 36% (720 choices of 2000) were made unanimously. The number of unanimous decisions did not change over time. We defined three situations regarding a group member's role in a specific decision: G3 is a member who chose the same box as the two other members (i.e., in a unanimous decision); G2 is a member who was in a majority of two; G1 is a member who was outvoted (i.e., chose a different box from the two other members). Note that these "roles" are for a given round, namely, someone who was G3 in a specific round could be G1 in a following round. Figure 3 presents the switch tendencies following all outcome combinations for each situation (G1, G2, G3).

Being accountable increases individuals' reactions to outcomes

We tested whether individuals who were accountable for the group outcome reacted more (or less) to their payoffs than individuals choosing only for themselves. We operationalize *accountability for outcome* in the following way. One's choice was implemented, and its consequences were carried out and determined one's payoff. One could be held accountable for this choice in the sense that one could be asked to justify the outcome, and could be

assigned credit or blame for it. This definition obviously includes SLF participants. In the GRP condition, this definition includes members in the majority, both unanimous – G3 – and non-unanimous – G2. Such cases are seemingly equivalent in that the received outcome corresponded to the subject's choice. The definition excludes G1, who were outvoted and whose choices were not implemented.

A logistic regression comparing choice dynamics of SLF to G2 and G3 revealed that G2 and G3 reacted more strongly to their outcome than SLF: As presented in Figure 3, G2 and G3 switched more than SLF if the chosen box did not yield a coin (*OR*=0.758, *z*=-2.04, *p*=.041). That is, individuals who were accountable for a group decision were more reactive to their outcome than individuals who made the choice for themselves only. However, G2 and G3 did not overall switch more or less than SLF (*OR*=1.285, *z*=1.04, *p*=.297).

Pivotal individuals react more strongly to outcomes.

To test for the added influence of pivotality in the decision on reactions to the outcome, we compared the switch tendencies of G2 to those of G3. These two situations are very similar as members in both G2 and G3 situations made a decision within a group, their decision was the majority decision, and as such it was implemented and determined their outcome. However, they differ on one important aspect: G2 were pivotal in the decision – had they made a different choice, the group decision would have been different; in contrast, a different choice made by G3 would not have led to a different group decision. Thus, G3 situations are the best baseline to examine the effect of pivotality on one's tendency to switch. Notably, as group members could experience both G2 and G3 situations across rounds, this comparison was within-person. The logistic regression variance was thus clustered by subject. G2 were marginally more prone to switch than G3 in general (*OR*=0.793, *z*=-1.94, *p*=.052), and switched more often than G3 following no coin (*OR*=0.848, *z*=-2.10, *p*=.036). Pivotality in the group decision increased the tendency to switch as well as the reactivity to outcomes.

Outvoted individuals react more strongly to outcomes

G1 were unique in our setting in that the choice they made was not realized: They were outvoted by two other members, whose choices determined the group decision and payoff. To test whether being outvoted influenced reactions to the two boxes' payoffs, we compared the switch tendencies of G1 to those of G2 and G3. A logistic regression demonstrated that overall, G1 switched more often than G2 and G3 (OR=1.343, z=2.14, p=.032), suggesting a tendency to move towards the box chosen by the majority. The tendency to switch was intensified when the box chosen by the group (and unchosen by G1) had contained a coin (OR=1.368, z=3.15, p=.002). Importantly, as seen in Figure 3, G1 were strongly influenced by the payoff in their own chosen box (OR=0.665, z=-4.25, p<.001) – even though it did not affect their payoff since it was not the one chosen by the group.

Discussion

In Experiment 1, we observed differences between individuals and voting groups in both the reactivity to outcomes and the aggregate choice frequencies over time. Group members took longer than individuals to reach the same plateau for aggregate decisions, and reacted more strongly to the previous outcome. This led to the increased reactivity of groups as units, compared to individuals, supporting Hypotheses 2a-c (opposing Hypotheses 1a-c).

There are several possible explanations for these differences. One possible explanation is that, given the weaker influence of each member (compared with individuals) on the final decision and payoff, subjects in the group condition felt less responsible (Latane et al., 1979; Wallach et al., 1964). This may have led them to behave more carelessly or less deliberately – learning slower than individuals. Yet, the stronger reactivity to outcomes evinced by group members may imply that they felt *more* – and not less – responsible than individuals. A second explanation lies in the information (feedback) given in the different conditions. In the group condition, subjects received not only feedback regarding the outcomes of both

alternatives (as in the individual condition), but also frequency feedback about the other group members' choices, and about the final group decision. This additional information may have confused the subjects (making them pay attention to various irrelevant cues; Lerner & Tetlock, 1999), or have led to cognitive load, causing subjects to need more time to learn the task and to decide on their preferred strategies. This conjecture is somewhat supported by the findings of Gustafson et al. (1973), observing that non-interacting groups who were given written feedback about the members' responses had worse performance compared to groups without feedback.

Experiment 2 provides insight into the source of the observed differences. We examined two possible sources, namely responsibility for others' payoffs, and feedback regarding others' decisions. To this end, in one condition (*LEAD*) a single individual made the decision for the entire group – thus, that individual alone determined everyone's payoff (similar to Van Swol & Sniezek, 2005); in another condition (*FDB*), individuals were provided with feedback regarding the choices of two other individuals in the session.

Experiment 2

Method

A hundred and twenty Hebrew University students participated in the experiment, in exchange for monetary compensation. Subjects played the same coin game of Experiment 1 with the same parameters, for 99 rounds. None of the subjects participated in Experiment 1.

The experimental conditions were between subjects. In both *FDB* and *LEAD* conditions, we randomly grouped subjects into 3-person groups, which remained fixed throughout the experiment, similar to the GRP condition of Experiment 1. In the *FDB* condition (n=24), subjects made their choices individually; each subject's payoff was determined only by the subject's own decision. At the end of each round, subjects received feedback about the

decisions of the two other subjects in their "group". Specifically, subjects saw how many in their 3-person "group" chose each box, as in Experiment 1's GRP condition.

In the *LEAD* condition (n=72), we told subjects that in each group, one subject would be randomly chosen to be the group leader. There were thus 24 leaders. The leaders' decisions would alone determine the payoff of all group members.[5] While the two other members played the game, their decisions had no impact on their payoff or that of others. At the beginning of the experiment, we told subjects whether they were the group leader or not. For the analyses, we examined only the group leaders (n=24).

These conditions were compared with a control *SLF* condition (n=24), identical to Experiment 1. That is, choices were made by individual subjects; each subject's payoff was determined only by their own decisions; they did not receive any information regarding other subjects.

The payoff rules in the three conditions were equivalent: Each coin in the chosen box added a point to subjects' till. Every five coins were worth 2 NIS. On average, subjects earned 21.26 NIS from the game plus a 5 NIS show-up fee. There was no difference in subjects' payoffs in the three conditions (FDB: M=21.33, SD=3.16; LEAD: M=21.33, SD=2.35; SLF: M=21.13, SD=2.79; all pairwise comparisons were insignificant, p's > .78).

At the end of the experiment, subjects in all conditions filled out a questionnaire regarding various aspects of decision making. It was used for another experiment and not analyzed here.

Results

Similar overall performance across conditions

We examined the rate of better box choices in the three conditions, finding that subjects chose the better box quite often. On average, the better box was chosen on 70.71% of the rounds (SD=0.263); this proportion was significantly higher than chance (t(71)=7.33, p<.001).

[5] This is akin to various dictatorship games (e.g., Charness & Jackson, 2009).

The location of the better box (right or left) again did not affect choices (t(70)=0.22, p=.829). Figure 4 presents the rate of better box choices over time in the three conditions.

We next compared the three conditions. Thus, we conducted a logistic regression on the rate of better box choices, with predictors being round (as a logarithmic function), condition indicator variables for FDB and LEAD, and condition*round interactions; variance was clustered by subject. As can be seen in the figure, in all conditions the rate of choosing the better box increased over time (*OR*=1.352, *z*=4.33, *p*<.001) – but was mostly stable after the first few rounds.

The rate of better box choices did not differ between conditions, as reflected in the non-significant effects of the two condition indicator variables (FDB: *OR*=1.487, *z*=0.95, *p*=.343; LEAD: *OR*=1.403, *z*=0.71, *p*=.479). As seen in Figure 4, the pattern of choices over time also did not differ between the three conditions: The interaction terms between each condition and round were insignificant (both *p*'s > .65).

Feedback decreases the tendency to switch (regardless of outcome)

Does the feedback given, or the subjects' responsibility for others' payoffs, account for the differential reactivity to outcomes observed in Experiment 1? We again examined whether subjects' tendency to switch from round to round could be explained by the previous outcome, and whether this differed by condition. Figure 5 presents the percent of switches in all three conditions as a function of the outcome of the chosen and unchosen boxes.

We submitted the "switch" variable to a logistic regression, with predictors being the previous choice (whether the better box was chosen), the payoffs in both chosen and unchosen boxes, condition indicator variables and condition*outcome interactions. Variance was again clustered by subject.

As presented in Figure 5, and similar to Experiment 1, when the chosen box did not contain a coin, subjects tended to switch (*OR*=0.685, *z*=-2.20, *p*=.028). Further, when one did

not receive a coin, one switched more often when there was a coin in the unchosen box (*OR*=0.858, *z*=-2.12, *p*=.034). Subjects also tended to switch more following a choice of the worse box (*OR*=0.308, *z*=-6.90, *p*<.001).

As for the experimental conditions, there was a significant difference between the FDB condition and the other two conditions: As seen in Figure 5, subjects in the FDB condition tended to switch *less overall* compared to subjects in the other two conditions (*OR*=0.480, *z*=-2.12, *p*=.034). However, the effect of outcomes in the FDB condition did not differ from that in the other conditions, as reflected in non-significant FDB*outcome interactions (all *p*'s > .68).

There was no difference in the overall rate of switching between the LEAD condition and the other conditions (*OR*=1.078, *z*=0.28, *p*=.780). There was also no difference in the effect of outcomes in this condition compared to the other conditions (all LEAD*outcome *p*'s > .10). However, as can be seen in Figure 5, subjects in the LEAD condition were slightly more likely to switch following an absence of a coin in the chosen box (*OR*=0.793, *z*=-1.64, *p*=.101). It is worth noting that while below significance, this result is in line with our hypothesis following Experiment 1, that responsibility for others' payoffs will increase subjects' reactivity to their outcomes.

We next wanted to see whether subjects took into account the *content* of the feedback: Did being in line versus in disaccord with others' choices influence subjects' reactivity and their tendency to switch overall?

Deviates switch irrespective of outcome; consensus decreases the tendency to switch

We look at the choice dynamics in the FDB condition, to examine whether the number of other individuals who chose similar to oneself affects the tendency to switch from round to round in general, and in light of the outcome.

As each subject saw two other subjects' choices, one could see three feedback "situations": that all three individuals chose the same box (denoted by F3), that one other individual chose the same as oneself (F2) or that one is a "deviate", namely that the two other individuals chose differently from one's own choice (F1). Of all decisions in the FDB condition, 47% choices (1116 of 2376) were unanimous – showing subjects an F3 feedback. Out of the 1250 (53%) non-unanimous decisions, in 840 decisions (35%) subjects were in the "majority", and saw F2, whereas in 420 decisions (18%) subjects saw F1.[6] The number of majority decisions (F2 and F3) did not change over time ($t(24)=1.32$, $p=0.200$). Figure 6 presents the switch tendencies following all outcome combinations for each feedback situation (F1, F2, F3).

We first compared the "deviate" to the "majority" (F1 versus F2 and F3) in order to examine whether seeing others' agreement or disagreement with one's choice affects the tendency to switch both overall and in light of the previous outcome (in the chosen and unchosen boxes). As shown in Figure 6, a regression of switch tendencies revealed that when subjects were in the "majority" – when they saw F2 or F3 feedback – they were somewhat more prone to switch following no coin in their chosen box ($OR_{chosen*F23}=0.778$, $z=-1.68$, $p=.094$). There were no other observed differences (all p's>.11).

We conducted two further analyses: One regression compared F1 to F2. As seen in Figure 6, when subjects saw that no other subject chose the same as they did, their tendency to switch was irrespective of either box's outcome ($OR_{chosen*unchosen*F2}=1.242$, $z=1.82$, $p=.068$). The second analysis compared F2 to F3, to see whether the number of "supporting" choices affects reactivity. We observed that in both situations, subjects were sensitive to the outcome in the unchosen box, in that they were more likely to subsequently switch to it if it had contained a coin ($OR=1.356$, $z=1.94$, $p=.053$). In addition, subjects who saw two supporting

[6] Obviously, two-thirds of the non-unanimous decisions were F2, and one-third was F1.

choices (F3) were slightly less likely to switch overall, regardless of outcome (*OR*=0.535, *z*=-1.76, *p*=.078).

Discussion

In Experiment 2, we tested whether feedback regarding others' choices and responsibility for others' payoffs affect choice dynamics. In all conditions, as in Experiment 1, we found that the previous outcome influenced subjects' subsequent decisions. Importantly, providing subjects with feedback pertaining to others' choices increased their overall tendency to repeat their previous choice – regardless of its outcome. Moreover, comparing different feedback "situations" hints that the feedback content plays a role in the choice dynamics: Lack of support for one's choice makes one less sensitive to one's own outcome; conversely, unanimous support for one's choice leads to a tendency to stick with that choice in the subsequent round. We discuss this further in the General Discussion.

We did not observe a significant influence of responsibility for others' payoffs on choice dynamics – leaders were not more, nor less, reactive to their outcomes. We return to this point in the General Discussion.

General Discussion

The present study focuses on the question of whether groups are more or less impulsive than individuals. Groups and individuals made repeated choices between two risky alternatives, allowing us to examine both the overall choice behavior, and the choice dynamics from round to round. Experiment 1 compared voting groups of three non-communicating members to individuals. We explored both the group behavior, and that of the individual group members. Experiment 2 begins to disentangle various social influences on the choice dynamics; we examined the roles of responsibility for others' payoffs, and of feedback regarding others' choices, in individuals' choice behavior.

In both experiments and across all conditions, we observed that choices were well predicted by the outcome of the most recent choice: both the received and the forgone payoffs affected the rate of switching between alternatives. Our results not only extend previous findings (Avrahami & Kareev, 2011; Camerer & Ho, 1999; Kareev et al., 2014; Nowak & Sigmund, 1993) to contexts beyond individual choice behavior: we show that the social context affects choice dynamics. Groups were not just *as* sensitive to their outcome as individuals, they were *more* sensitive to their outcome. Groups' reactions were more extreme – whether in sticking more with a choice that yielded a gain, or in moving away from a choice that did not. In order to understand groups' reactivity, we explored the reactivity of group *members*. In what follows, we describe our results in light of several potential psychological mechanisms.

Influence of responsibility

Group members might feel more responsible compared to individuals choosing only for themselves, since each member's choice involved other members' payoffs. In Experiment 1 we observed that group members who were part of a majority (whose choice determined the group decision) reacted more strongly to the outcome of their choice than did individuals choosing only for themselves. The responsibility hypothesis was further supported by the difference between pivotal and non-pivotal majority members (group members who were part of a non-consensus majority, versus those in a consensus): Pivotal members, who had more responsibility over the outcome (Lagnado et al., 2013), reacted more strongly to the outcome of their choice.

We examined the responsibility hypothesis in the LEAD condition in Experiment 2: The "leader" subject's choices solely determined the payoff of two other subjects. The results were ordinally in line with the above, in that the "leaders" were somewhat more reactive than individuals choosing only for themselves. However, the results were not statistically

significant, suggesting that forces other than responsibility play a role in group members' (and thus, groups') choice behavior.

Information about others' choices

Group members differed from individuals in that group members received information regarding others' choices. This difference could have led to the difference in choice dynamics. In both experiments, subjects took into account others' previous choices when making their own choice. In Experiment 1, members who were outvoted – who saw that the two other members made the opposite choice – tended to change their choices more often than did other members. Experiment 2 extended these results to situations in which subjects were not part of a group, but only received information regarding two other subjects. People who saw that their choice deviated from that of others were more likely to switch overall, independently of their outcome in that round. Conversely, when all three subjects chose the same alternative, subjects had a stronger tendency to stick with their previous choice, compared to seeing only one supporting choice or none at all. We outline several possible explanations for the influence of the social information.

Conformity

Conformity, namely choosing the same as others, might provide an intrinsic reward, in and of itself, on top of the external monetary payoff (Asch, 1956; Simon 1957). Conversely, deviating from the majority choice might trigger an intrinsic punishment. That is, subjects may have tried to achieve a unanimous voting in as many rounds as possible, at least be in the majority as often as possible. Neuroscientific evidence supports the conformity explanation, showing that conflicting with others' opinions triggers neural error responses (Kimura & Katayama, 2015; Klucharev et al., 2009). This intrinsic, social, reward (or punishment) might have diminished the importance of the monetary payoff, and reduced the tendency to switch after a bad outcome.

Others' choices as information

Subjects might have looked at others' choices as a source of information regarding the quality of their own choices. When a consensual or unanimous choice did not yield a gain, subjects might have felt vindicated by others' choices: instead of attributing the bad outcome to a bad decision, subjects might have been more prone to interpret it as mere bad luck. This explanation, like conformity, would lead to weaker reactivity to outcomes, as taking into account social information might dilute the informational value of the monetary payoff.

Self-presentation concerns

Subjects in our experiments knew that their choices were visible to others, just as they saw other members' choices. The mere presence of others has been shown to influence behavior (for reviews, see Bond & Titus, 1983; Guerin, 1986). Subjects may have felt accountable for their choices (Lerner & Tetlock, 1999), or had self-presentation concerns, that is, a desire to present themselves in a favorable light (Baumeister, 1982). In the FDB condition, self-presentation concerns could have pushed subjects to try to appear as more consistent or less impulsive than what they are when unobserved - hence to less switches overall. In the LEAD condition, this consideration could also play a role, yet other forces such as responsibility could outweigh it.

Choices as signals

It could also be that subjects used their visibility to others as a mean of communication. Subjects may have tried to signal to others which box was the better one, or what strategy to use. This could explain diminished reactivity to outcomes: one might want to make one's "point" clear to others by choosing the same alternative consistently. We believe this is an unlikely explanation for the results of Experiment 2, since signaling is less likely when others' choices do not affect one's outcome. Future studies could directly test the signaling hypothesis by repeating the FDB condition where the composition of groups changes from round to

round. In such settings, subjects would not be able to learn anything from others, or teach them anything.

Cognitive load

The mere presence of feedback regarding others' choices (either as a group or as independent feedback), could conceivably have impaired subjects' decisions. The additional information could increase subjects' cognitive load (Lerner & Tetlock, 1999). This could potentially explain why subjects in the FDB condition of Experiment 2 switched less than individuals who did not see others' choices. However, we believe that this explanation is not very likely given the similar overall performance across conditions.

Importantly, social information – both observing others' choices, and being visible to others – cannot explain groups' increased reactivity compared to individuals: Whereas in Experiment 1 groups and group members were more reactive to their outcome than individuals, in Experiment 2 subjects who received feedback did not show this effect, and tended to repeat their previous choice.

Conclusion

The combined results of Experiment 1 and Experiment 2 raise several interesting points. One of which is that both responsibility and information play important parts in determining groups' choice behavior, and differentiating it from that of individuals. A second, following, point is that neither responsibility nor information can alone account for the differences between groups and individuals. A likely explanation is that the combination of responsibility and accountability is that which distinguishes voting groups' behavior from that of individuals. That is, it is not enough to be responsible for others; it is necessary to also be viewed as responsible – and be aware of this – as well as have the opportunity to view or conform to others' choices. Future studies could address these considerations, and their impact on choice behavior.

Our findings have several important implications for decision making in costly, risky and repeated settings. They qualify the common intuition that groups are more levelheaded than individuals are. Groups' increased reactivity to outcomes may constitute an advantage or a disadvantage, depending on the potential consequences of the decision. When decisions entail highly substantial losses, such as investment choices, drug approvals or military deployment, groups might make better choices due to their increased reactivity. However, this volatility can also be detrimental, for example, when transitions are costly in time, effort or money.

We show that groups are not necessarily better decision-makers. In contrast with problem solving or judgment tasks, in risky decisions there seems to be no advantage to entrusting the decision to groups rather than to individuals. Given that group decision making is often more financially taxing, difficult or time consuming to achieve, such decisions might be better left to a single individual.

References

Ambrus, A., Greiner, B., & Pathak, P. A. (2015). How individual preferences are aggregated in groups: An experimental study. *Journal of Public Economics, 129*, 1–13.

Asch, S. E. (1951). Effects of group pressure upon the modification and distortion of judgments. In H. Guetzkow (Ed.), *Groups, leadership and men*. Pittsburg, PA: Carnegie Press.

Asch, S. E. (1956). Studies of independence and conformity: A minority of one against a unanimous majority. *Psychological Monographs, 70*(9), 1-70.

Avrahami, J., & Kareev, Y. (2011). The role of impulses in shaping decisions. *Journal of Behavioral Decision Making, 24*(5), 515–529.

Baron, R. S. (1986). Distraction-conflict theory: Progress and problems. *Advances in Experimental Social Psychology, 19*, 1-39.

Barron, G., & Erev, I. (2003). Small feedback-based decisions and their limited correspondence to description-based decisions. *Journal of Behavioral Decision Making, 16*, 215-233.

Baumeister, R. F. (1982). A self-presentational view of social phenomena. *Psychological Bulletin, 91*(1), 3-26.

Bettenhausen, K., & Murnighan, J. K. (1985). The emergence of norms in competitive decision-making groups. *Administrative Science Quarterly*, 350-372.

Blinder, A. S. (2007). Monetary policy by committee: Why and how? *European Journal of Political Economy, 23*(1), 106-123.

Blinder, A. S., & Morgan, J. (2005). Are two heads better than one? Monetary policy by committee. *Journal of Money, Credit and Banking, 37*(5), 789-811.

Bond, C. F., & Titus, L. J. (1983). Social facilitation: a meta-analysis of 241 studies. *Psychological Bulletin, 94*(2), 265-292.

Bornstein, G. (2008). A classification of games by player type. In: Biel A, Eek D, Gärling T & Gustafsson M (eds.), *New issues and paradigms in research on social dilemmas* (pp. 27-42). Berlin, Germany: Springer-Verlag.

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

Bornstein, G., Erev, I., & Goren, H. (1994). The effect of repeated play in the IPG and IPD team games. *Journal of Conflict resolution*, *38*(4), 690-707.

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*(5), 599-605.

Bornstein, G., Kugler, T., Budescu, D. V., & Selten, R. (2008). Repeated price competition between individuals and between teams. *Journal of Economic Behavior & Organization, 66*(3), 808-821.

Briley, D. A., & Wyer, R. S. (2002). The effects of group membership on the avoidance of negative outcomes: Implications for social and consumer decisions. *Journal of Consumer Research, 29*(3), 400-415.

Camerer, C., & Ho, T. H. (1999). Experience-weighted attraction learning in normal form games. *Econometrica, 67*, 827-874.

Charness, G., & Jackson, M. O. (2009). The role of responsibility in strategic risk-taking. *Journal of Economic Behavior & Organization*, *69*(3), 241-247.

Charness, G., & Sutter, M. (2012). Groups make better self-interested decisions. *Journal of Economic Perspectives, 26*, 157–176.

Charness, G., Karni, E., & Levin, D. (2007). Individual and group decision making under risk: An experimental study of Bayesian updating and violations of first-order stochastic dominance. *Journal of Risk and Uncertainty*, *35*(2), 129-148.

Cohen, T., & Thompson, L. (2011). When are teams an asset in negotiations and when are they a liability? In E. Mannix, M. Neale, & J. Overbeck (Eds.), *Research on managing groups and teams: Negotiation in groups* (Vol. 14, pp. 3–34). Bingley: Emerald.

Cooper, D. J., & Kagel, J. H. (2005). Are two heads better than one? Team versus individual play in signaling games. *American Economic Review, 95*(3), 477-509.

Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology, 53*(3), 497-509.

Erev, I., & Barron, G. (2005). On adaptation, maximization and reinforcement learning among cognitive strategies. *Psychological Review, 112*, 912-931.

Ert, E., & Erev, I. (2007). Replicated alternatives and the role of confusion, chasing, and regret in decisions from experience. *Journal of Behavioral Decision Making, 20*, 305-322.

Guerin, B. (1986). Mere presence effects in humans: A review. *Journal of Experimental Social Psychology, 22*(1), 38-77.

Gustafson, D. H., Shukla, R. K., Delbecq, A., & Walster, G. W. (1973). A comparative study of differences in subjective likelihood estimates made by individuals, interacting groups, Delphi groups, and nominal groups. *Organizational Behavior and Human Performance, 9*(2), 280-291.

Hart, E., Kareev, Y., & Avrahami, J. (2016). Good times, bad times: Reversal of risk preferences. *Decision, 3(2),* 132.

Hastie, R., & Kameda, T. (2005). The robust beauty of majority rules in group decisions. *Psychological Review*, 112(2), 494-508.

Hertwig, R., & Erev, I. (2009). The description–experience gap in risky choice. *Trends in Cognitive Sciences, 13,* 517-523.

Hertwig, R., Barron, G., Weber, E., & Erev, I. (2004). Decisions from experience and the effect of rare events in risky choice. *Psychological Science, 15*, 534–539.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin, 121*, 43–64.

Isenberg, D. J. (1986). Group polarization: A critical review and meta-analysis. *Journal of Personality and Social Psychology, 50*(6), 1141-1151.

Janis, I. L. (1972). *Victims of groupthink.* Boston: Houghton-Mifflin.

Janis, I. L. (1982). *Groupthink: Psychological studies of policy decisions and fiascoes*. Boston: Houghton-Mifflin.

Kahneman, D., & Tversky, A. (1982). The psychology of preferences. *Scientific American, 246*, 160-173.

Kameda, T., & Davis, J. H. (1990). The function of the reference point in individual and group risk decision making. *Organizational Behavior and Human Decision Processes*, 46(1), 55-76.

Karau, S. J., & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology, 65*(4), 681-706.

Kareev, Y., Avrahami, J., & Fiedler, K. (2014). Strategic interactions, affective reactions, and fast adaptations. *Journal of Experimental Psychology: General, 143*(3), 1112-1126.

Kerr, N. L., & Tindale, R. S. (2004). Group performance and decision making. *Annual Review of Psychology, 55*, 623-655.

Kerr, N. L., MacCoun, R., & Kramer, G. P. (1996). Bias in judgment: Comparing individuals and groups. *Psychological Review, 103*, 687-719.

Kimura, K., & Katayama, J. (2015). Cooperative context is a determinant of the social influence on outcome evaluation: An electrophysiological study. *International Journal of Psychophysiology*, Available online 23 December 2015, ISSN 0167-8760.

Klucharev, V., Hytönen, K., Rijpkema, M., Smidts, A., & Fernández, G. (2009). Reinforcement learning signal predicts social conformity. *Neuron, 61*(1), 140-151.

Kugler, T., Kausel, E. E., & Kocher, M. G. (2012). Are groups more rational than individuals? A review of interactive decision making in groups. *Wiley Interdisciplinary Reviews: Cognitive Science*, *3*(4), 471-482.

Lagnado, D. A., Gerstenberg, T., & Zultan, R. I. (2013). Causal responsibility and counterfactuals. *Cognitive Science, 37*(6), 1036-1073.

Larrick, R. P., & Soll, J. B. (2006). Intuitions about combining opinions: Misappreciation of the averaging principle. *Management Science, 52*(1), 111-127.

Latane, B., Williams, K., & Harkins, S. (1979). Many hands make light the work: The causes and consequences of social loafing. *Journal of Personality and Social Psychology, 37*(6), 822-832.

Laughlin, P. R. (1980). Social combination processes of cooperative problem-solving groups on verbal intellective tasks. *Progress in Social Psychology, 1*, 127-155.

Laughlin, P. R., & Ellis, A. L. (1986). Demonstrability and social combination processes on mathematical intellective tasks. *Journal of Experimental Social Psychology, 22(3)*, 177-189.

Laughlin, P. R., Bonner, B. L., & Miner, A. G. (2002). Groups perform better than the best individuals on letters-to-numbers problems. *Organizational Behavior and Human Decision Processes, 88(2)*, 605-620.

Lejarraga, T., & Müller-Trede, J. (2016). When experience meets description: How dyads integrate experiential and descriptive information in risky decisions. *Management Science.*

Lejarraga, T., Dutt, V., & Gonzalez, C. (2012). Instance-based learning: A general model of repeated binary choice. *Journal of Behavioral Decision Making*, *25*(2), 143-153.

Lejarraga, T., Lejarraga, J., & Gonzalez, C. (2014). Decisions from experience: How groups and individuals adapt to change. *Memory & Cognition, 42*(8), 1384-1397.

Lerner, J. S., & Tetlock, P. E. (1999). Accounting for the effects of accountability. *Psychological Bulletin, 125*(2), 255-275.

Levinger, G., & Schneider, D. J. (1969). Test of the "risk is a value" hypothesis. Journal of Personality and Social Psychology, 11(2), 165–169.

Li, P., Jia, S., Feng, T., Liu, Q., Suo, T., & Li, H. (2010). The influence of the diffusion of responsibility effect on outcome evaluations: Electrophysiological evidence from an ERP study. *Neuroimage, 52*(4), 1727-1733.

Mellers, B., Schwartz, A., & Ritov, I. (1999). Emotion-based choice. *Journal of Experimental Psychology: General, 128*(3), 332.

Moscovici, S., & Zavalloni, M. (1969). The group as a polarizer of attitudes. *Journal of personality and social psychology, 12*(2), 125-135.

Nowak, M.A., & Sigmund, K.A. (1993). A strategy of win-stay, lose-shift that outperforms tit-for-tat in the prisoner's dilemma game. *Nature, 364*, 56-58.

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies, 22*(1), 435-480.expei

Rakow, T., & Miler, K. (2009). Doomed to repeat the successes of the past: History is best forgotten for repeated choices with non-stationary payoffs. *Memory and Cognition, 37*, 985-1000.

Rockenbach, B., Sadrieh, A., & Mathauschek, B. (2007). Teams take the better risks. *Journal of Economic Behavior and Organization*, *63*(3), 412-422.

Seligman, M. E. P. (1975). *Helplessness*. San Francisco: Freeman.

Selten, R., Abbink, K., & Cox, R. (2005). Learning direction theory and the winner's curse. *Experimental Economics, 8*, 5–20.

Simmons, J. P., & Nelson, L. D. (2006). Intuitive confidence: choosing between intuitive and non-intuitive alternatives. *Journal of Experimental Psychology: General, 135*(3), 409.

Simmons, J. P., Nelson, L. D., Galak, J., & Frederick, S. (2011). Intuitive biases in choice versus estimation: Implications for the wisdom of crowds. *Journal of Consumer Research, 38*(1), 1-15.

Simon, H. A. (1957). *Models of man: Social and rational.* Oxford, England: Wiley.

Soll, J. B., & Larrick, R. P. (2009). Strategies for revising judgment: how (and how well) people use others' opinions. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35* (3), 780–805.

Steiner, I. D. (1972). *Group process and productivity*. New York: Academic Press.

Sunstein, C. R. (2006). *Infotopia: How many minds produce knowledge*. New York: Oxford University Press.

Surowiecki, J. (2004). *The Wisdom of Crowds.* New York: Doubleday

Taylor, D. W., Berry, P. C., & Block, C. H. (1958). Does group participation when using brainstorming facilitate or inhibit creative thinking? *Administrative Science Quarterly,* 23-47.

Tetlock, P. E., & Boettger, R. (1994). Accountability amplifies the status quo effect when change creates victims. *Journal of Behavioral Decision Making, 7*(1), 1-23.

Thorndike, E. L. (1927). The law of effect. *The American Journal of Psychology, 39,* 212-222.

Tian, T., Feng, X., Gu, R., Broster, L. S., Feng, C., Wang, L., Guan, Q. & Luo, Y. J. (2015). Modulation of the brain activity in outcome evaluation by the presence of an audience: An electrophysiological investigation. *Brain research.*

Van Swol, L. M., & Sniezek, J. A. (2005). Factors affecting the acceptance of expert advice. *The British Journal of Social Psychology, 44(3),* 443–61.

Vroom, V. H., Grant, L. D., & Cotton, T. S. (1969). The consequences of social interaction in group problem solving. *Organizational Behavior and Human Performance, 4*(1), 77-95.

Wallach, M. A., Kogan, N., & Bem, D. J. (1964). Diffusion of responsibility and level of risk taking in groups. *Journal of Abnormal and Social Psychology, 68*(3), 263-274.

Whyte, G. (1993). Escalating commitment in individual and group decision making: A prospect theory approach. *Organizational Behavior and Human decision Processes, 54*(3), 430-455.

Williams, R. L. (2000). A note on robust variance estimation for cluster-correlated data. *Biometrics, 56*(2), 645-646.

Yechiam, E., & Busemeyer, J. R. (2005). Comparison of basic assumptions embedded in learning models for experience based decision-making. *Psychonomic Bulletin & Review, 12*, 387-402.

Yechiam, E., & Busemeyer, J. R. (2006). The effect of foregone payoffs on underweighting small probability events. *Journal of Behavioral Decision Making, 19*, 1-16.

Yechiam, E., & Rakow, T. (2011). The effect of foregone payoffs on choices from experience: An individual level modeling analysis. *Experimental Psychology, 13*, 1-13.

Zajonc, R. B. (1965). Social facilitation. *Science, 149*(3681), 269-274.

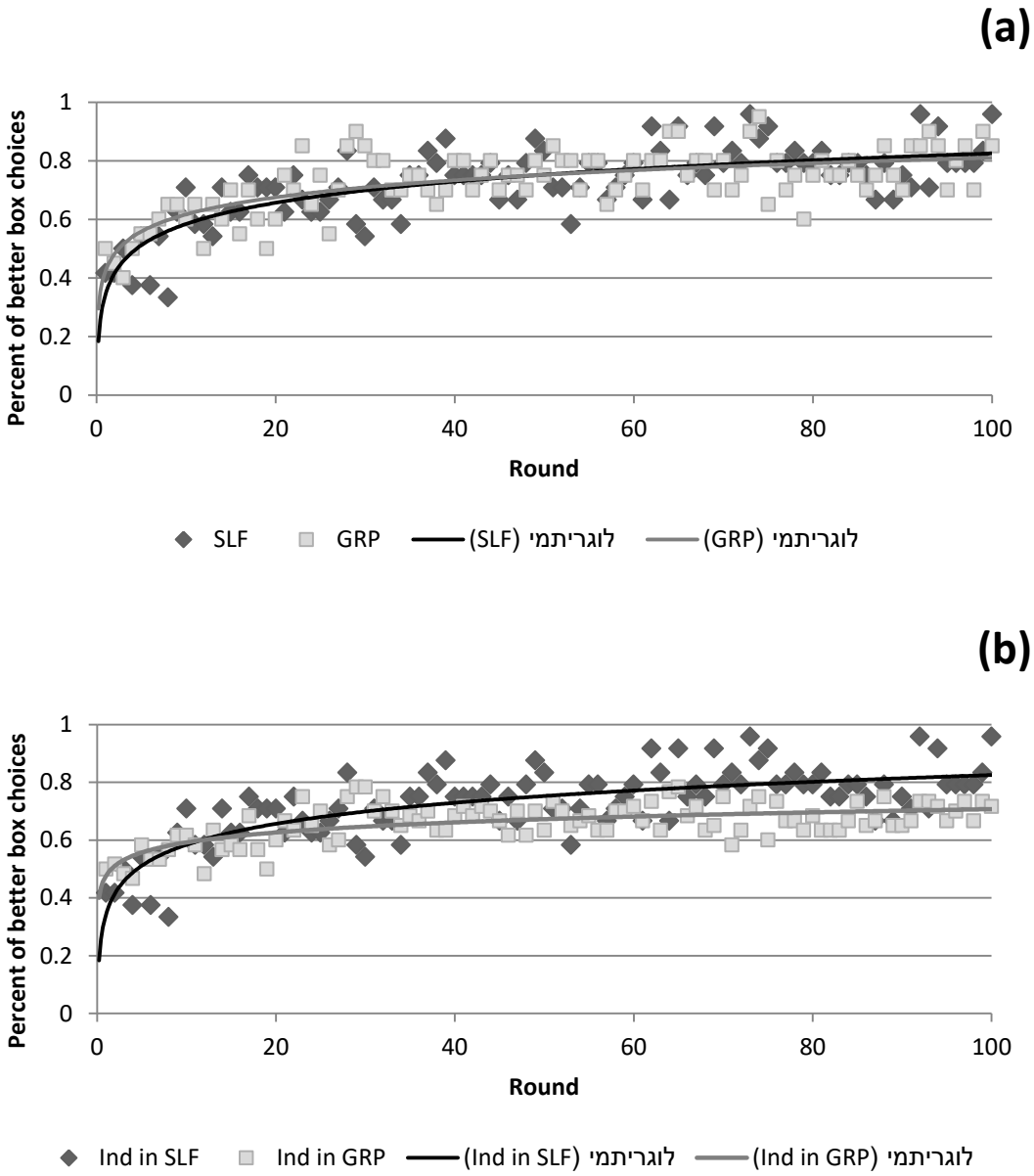

Figure 1. Percent of choices of the better box over time in the GRP and SLF conditions, including a logarithmic regression line. (a) For decision units: Entire groups compared with individuals who chose only for themselves; (b) for individuals: group members in GRP compared with individuals who chose only for themselves.

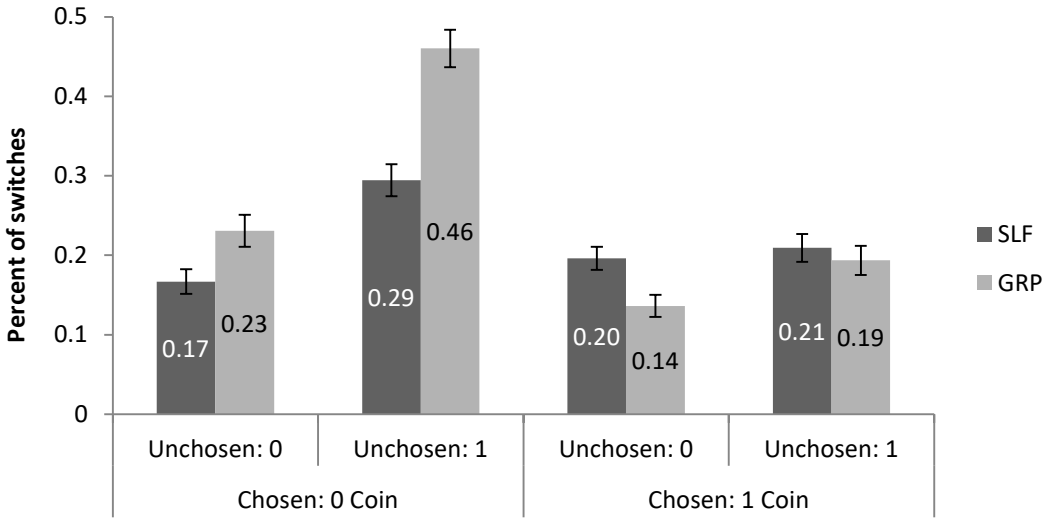

Figure 2. Percent of "switches" from the previous choice as a function of the outcome of the chosen and unchosen box, for SLF and GRP as decision units. Error bars represent standard errors.

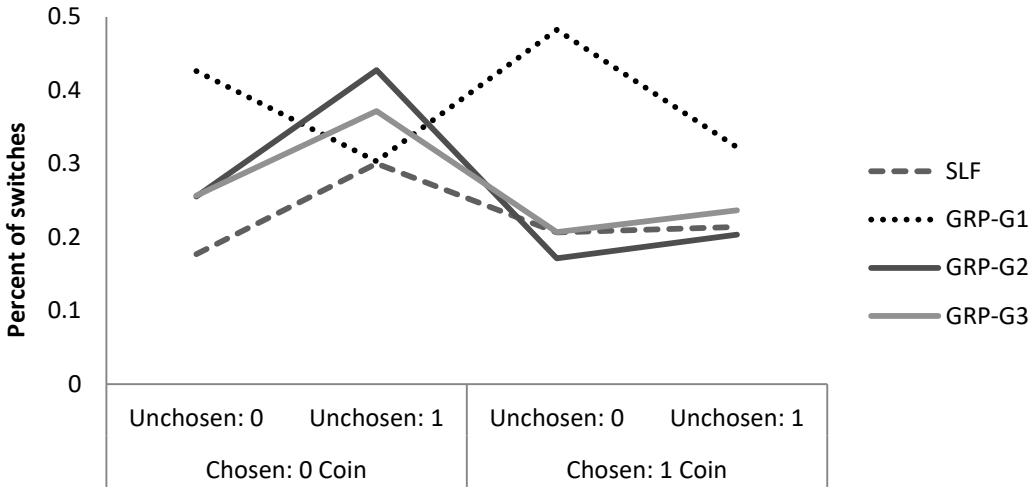

Figure 3. Percent of "switches" from the previous choice as a function of the outcome of the chosen and unchosen box, for SLF and each individual in GRP by the individual's role in the decision (G1, G2, G3).

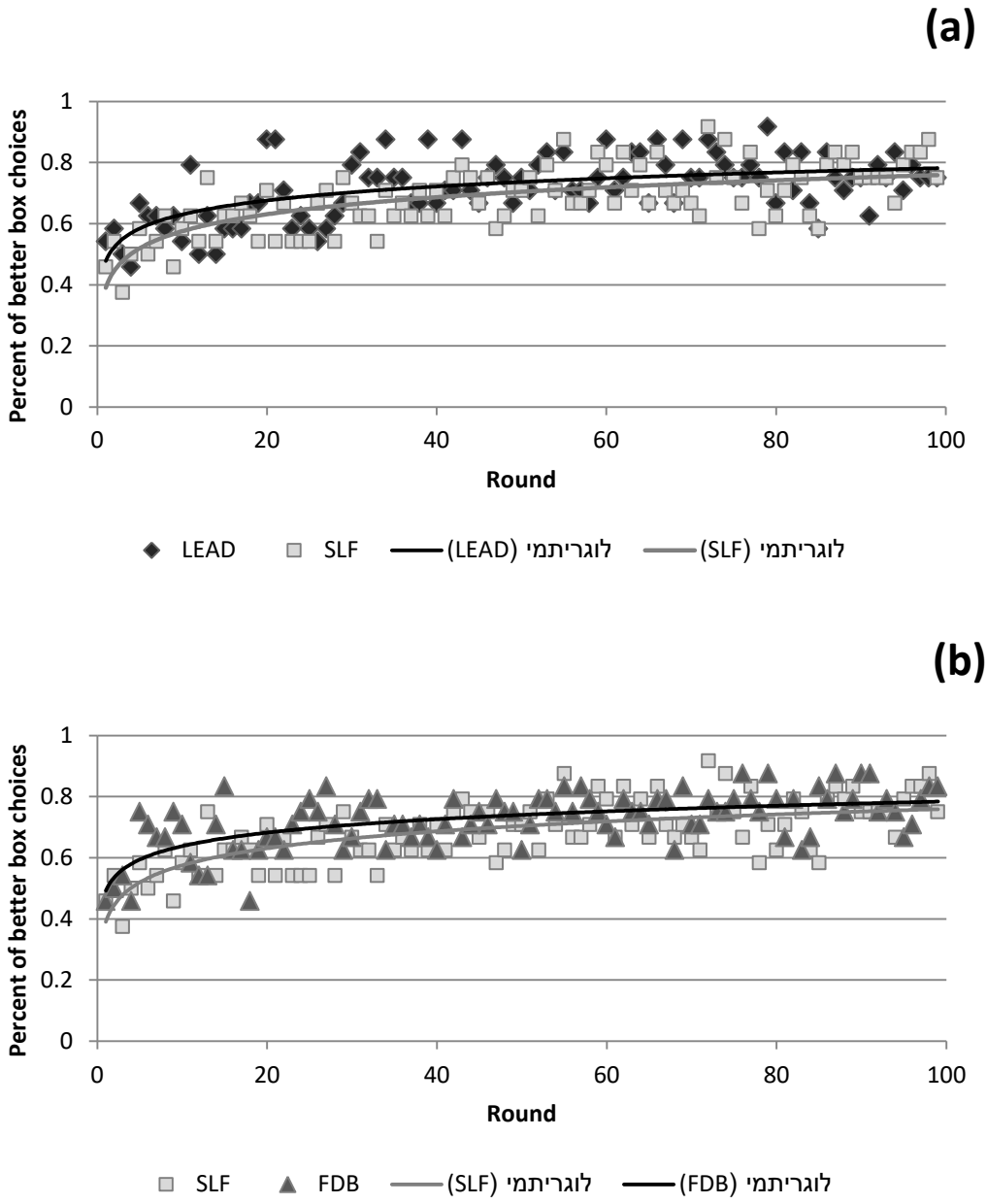

Figure 4. Percent of choices of the better box over time in the different conditions, including a logarithmic regression line. (a) LEAD and SLF; (b) FDB and SLF.

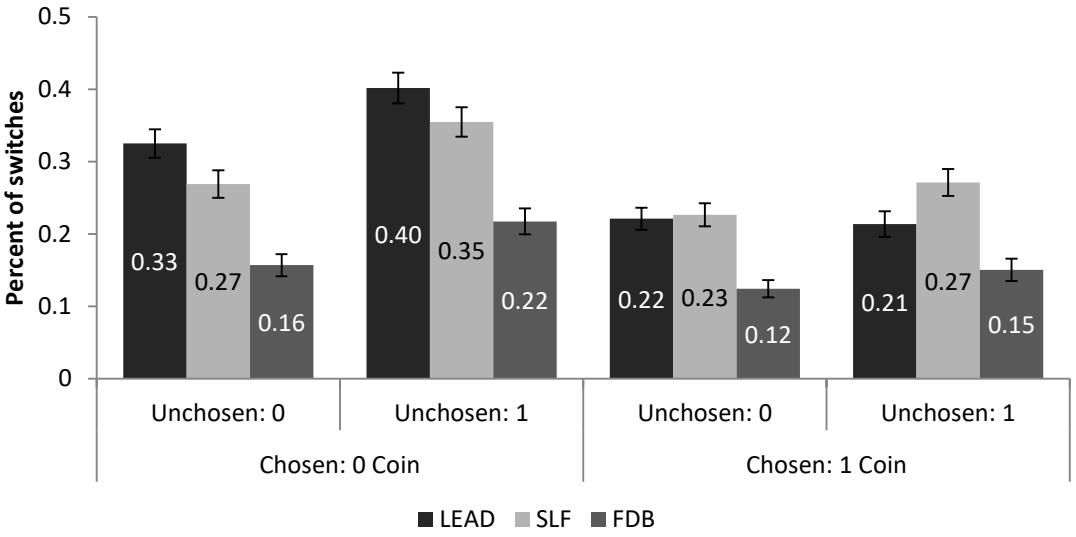

Figure 5. Percent of "switches" from the previous choice as a function of the outcome of the chosen and unchosen box, for LEAD, SLF and FDB conditions. Error bars represent standard errors.

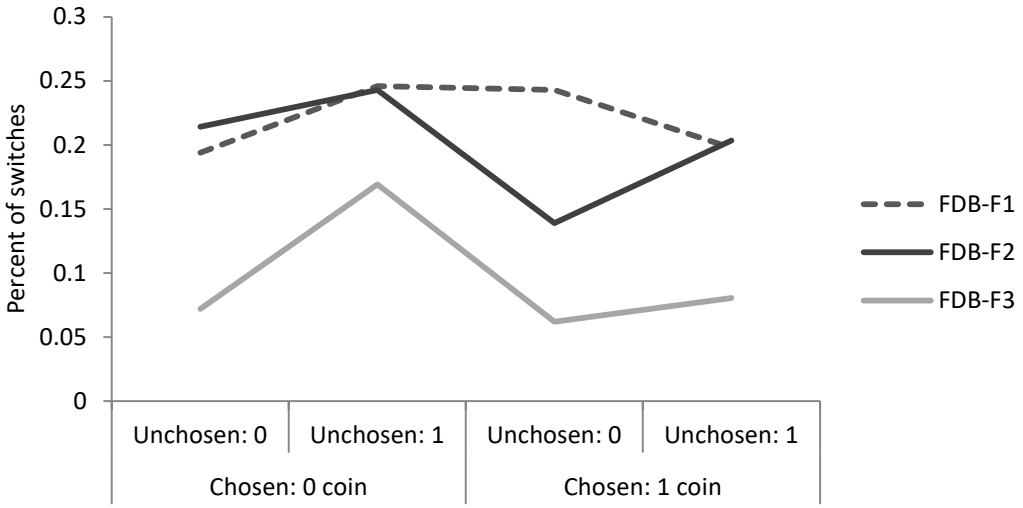

Figure 6. Percent of "switches" from the previous choice as a function of the outcome of the chosen and unchosen box, for individual in FDB by the number of individuals who chose that same box (F1, F2, F3).

Appendix: Instructions (translated from Hebrew)

Experiment 1

Hello and welcome to a decision making experiment.

In this game you can accumulate points, which will be converted to money at the end of the experiment.

[**SLF:** Each participant in the room will play the game by themselves. Each participant's payoff will be determined only by their own decisions.]

[**GRP:** In the beginning of the game, the computer will group the participants in fixed groups of three participants each. That is, you will play the entire game with the same participants. Each participant's payoff will be determined by their own decisions and those made by the members of their group.]

The game will consist of 100 rounds. In each round, you will be asked to choose (by clicking the mouse) between two closed boxes appearing on the screen.

In each round, there could be a coin – or no coin – in each of the boxes.

The probability of each box containing a coin is fixed, and won't change throughout the game. For each box there is a specific probability of a coin, and this probability is independent of the probability of there being a coin in the other box. That is, in each round, there may be a coin in one box and not in the other; there may be no coin in either box; there may be coins in both boxes.

[**GRP:** After all participants have made their choice, the computer will aggregate the decisions made within each group: The box that received the majority of votes within a group will be that group's choice.

You will also be able to see how many of your group members voted for each box.]

After all participants have made their choice, both boxes will open. There will be a purple frame around the box you have chosen. [**GRP:** There will be a green frame around the box chosen by the majority of members in your group.]

[**SLF:** If the box chosen by you contains a coin, a point will be added to your till.]

[**GRP:** If the box chosen by your group contains a coin, a point will be added to the till of each group member.]

A counter on the screen will display how many points you have accumulated thus far.

At the end of the experiment, the points will be converted to money, with every two points worth one New Israeli Shekel.

At any point during the experiment, if you have any questions please raise your hand and an experimenter will approach you.

Experiment 2

Hello and welcome to a decision making experiment.

In this game you can accumulate points, which will be converted to money at the end of the experiment.

[**SLF & FDB:** Each participant in the room will play the game by themselves. Each participant's payoff will be determined only by their own decisions.]

[**LEAD:** In the beginning of the game, the computer will group the participants to fixed groups of three participants each. That is, you will play the entire game with the same participants. Each participant's payoff will be determined as explained below.]

The game will consist of 99 rounds. In each round, you will be asked to choose (by clicking the mouse) between two closed boxes appearing on the screen.

In each round, there could be a coin – or no coin – in each of the boxes.
The probability of each box containing a coin is fixed, and won't change throughout the game. For each box there is a specific probability of a coin, and this probability is independent of the probability of there being a coin in the other box. That is, in each round, there may be a coin in one box and not in the other; there may be no coin in either box; there may be coins in both boxes.

[**SLF & FDB:**
After all participants have made their choice, there will be a purple frame around the box you have chosen.
Both boxes will open, and you will see whether there was or wasn't a coin in each box.
{**FDB**: In addition, in each round, you will be shown the decisions of two other participants. The identity of these participants will remain fixed throughout the experiment. That is, in each round you will see the decisions made by the same two participants.}

Determining the payoff:
If the box chosen by you contains a coin, a point will be added to your till]

[**LEAD**:

Determining the payoff:

At the beginning of the experiment, the computer will randomly select one of the three group members to be the "**Leader**".

Each participant will know whether they have been selected as the leader or not selected.

The leader will be the one determining the group choice and the payoff for all group members. For each round, if the box chosen by the leader contains a coin, a point will be added to each member's till. In other words, the payoff of each group member will be determined solely by the leader's decisions.

After all participants have made their choice, there will be a purple frame around the box chosen by the leader.

Both boxes will open, and you will see whether there was or wasn't a coin in each box.]

At the end of the experiment, the points will be converted to money, with every 5 points worth 2 New Israeli Shekels.

At any point during the experiment, if you have any questions please raise your hand and an experimenter will approach you.