Facing Your Opponents: Social Identification and Information Feedback in Contests

Shakun D. Mago [a]
Anya C. Samak [b]
Roman M. Sheremeta [c *]

[a] Department of Economics, Robins School of Business, University of Richmond,
1 Gateway Road, Richmond, VA 23173, USA
[b] School of Human Ecology, University of Wisconsin-Madison
1300 Linden Drive, Madison, WI 53705, U.S.A.
[c] Weatherhead School of Management, Case Western Reserve University
and the Economic Science Institute, Chapman University
11119 Bellflower Road, Cleveland, OH 44106, U.S.A.

June 13, 2014

Abstract

We experimentally investigate the effect of social identification and information feedback on individual behavior in contests. In all treatments we find significant over-expenditure of effort relative to the standard theoretical predictions. Identifying subjects through photo display decreases wasteful effort. Providing information feedback about others' effort does not affect the aggregate effort, but it decreases the heterogeneity of effort and significantly affects the dynamics of individual behavior. A behavioral model which incorporates a non-monetary utility of winning and relative payoff maximization explains significant over-expenditure of effort. It also suggests that decrease in 'social distance' between group members through social identification promotes pro-social behavior and decreases over-expenditure of effort, while improved information feedback decreases the heterogeneity of effort.

JEL Classifications: C72, C91, D72, D74,
Keywords: contest, information, identification, over-expenditure, experiments

* Corresponding author: Roman M. Sheremeta, E-mail: rms246@case.edu
We would like to thank the Editor of the *Journal of Conflict Resolution* and two anonymous referees for thoughtful and constructive comments. For helpful discussions and comments, we thank Jim Andreoni, Subhasish Chowdhury, Cary Deck, Joan Esteban, Uri Gneezy, Ernan Haruvy, Erik Kimbrough, Kai Konrad, Sherry Li, John Morgan, Brian Roberson, Sally Sadoff, Karim Sadrieh, Tim Salmon, Tim Shields, as well as seminar participants at the University of Texas at Dallas, the University of California at San Diego, participants at the Western Economics Association International Conference, the Alliances and Alliance Formation in Conflict Workshop, and the Bay Area Behavioral and Experimental Economics Workshop. We thank University of Richmond for generous funding of this project and Kory Garner for help in conducting experiments. The usual disclaimers apply.

1. Introduction

Individuals participating in contests and tournaments encounter disparate information feedback settings. Fellow contestants may be known or unknown, and their effort level may be observable or unobservable. In some contests, such as competition for a new job or admission to a university, fellow contestants are typically unknown and their effort level is unobservable. In other contests, such as promotions in the workplace and political races, fellow contestants are often known and their effort level is observable. In patent races, opponents are usually known but their effort is unobservable. Such design details can potentially have strong bearing on individual and group behavior, yet existing theory provides little guidance on their effect on decision-making.

Since the early attempts of Bull et al. (1987) and Millner and Pratt (1989), experimental literature on contests has been rapidly expanding, encompassing facets such as player asymmetry, entry costs, risk preferences, and contest structure; for a comprehensive review see Dechenaux et al. (2014). However, most existent laboratory studies focus on the actions of agents where the identity of the opponents is unknown and where there is *ex post* complete information feedback about opponents' efforts. We argue that knowing the opponents' identities and effort levels are important design features that can influence individual behavior in practice (Smither et al., 2005). For instance, workplace managers may choose to explicitly identify the workers being considered for a promotion and make known their effort level, or managers may choose to keep workers' identities unknown (Harbring et al., 2007; Gürtler and Harbring, 2010).

We use a controlled laboratory experiment to investigate the effect of social identification and information feedback on individual and group behavior in a lottery contest, where individuals exert effort in order to win a prize. We consider a contest structure where higher

effort leads to more socially wasteful outcomes (i.e., rent-seeking or lobbying). Using this structure, we compare an information setting where all group members are completely anonymous to one where the identity of each group member is fully revealed to others using the member's photo and first name. We also compare information conditions in which members do not learn about other group members' effort to one where they receive full information feedback about each group member's effort.

In all treatments, we find significant over-expenditure of effort relative to the standard theoretical predictions. This is in line with previous experimental results in the contest literature; see Sheremeta (2013) for an overview. Identifying subjects through photo display decreases wasteful effort by 17%. Providing information feedback about others' effort does not affect the aggregate effort but it decreases the heterogeneity of effort, and it also significantly affects the dynamics of individual behavior. A behavioral model that incorporates a non-monetary utility of winning and relative payoff maximization explains significant over-expenditure of effort. It also suggests that decrease in 'social distance' between group members through social identification promotes pro-social behavior and decreases over-expenditure of effort, while improved information feedback decreases the heterogeneity of effort.

The rest of the paper is organized as follows: Section 2 provides an overview of the related literature and highlights our contribution. Section 3 presents the theoretical model that we use as a benchmark for our results. Section 4 details the experimental design and procedures. In Section 5, we report the main results of the experiment, and in Section 6, we provide behavioral explanations of our results. Finally, in Section 7, we discuss the application of our findings as well as suggest directions for future research.

2. Related Literature

Our study contributes to the literature investigating how social identification may impact economic behavior in social dilemmas. In our experiment, group members are identified using digital passport-style photos and their names. Showing faces can affect subjects' behavior. For instance, Bohnet and Frey (1999a, 1999b) and Burnham (2003) find that visual identification increases cooperation in prisoner's dilemma and dictator games. Eckel and Wilson (2006) find that seeing one's partner impacts trust and trustworthiness. Scharlemann et al. (2001) find that smiles can elicit cooperation among strangers in a one-shot bargaining interaction. Also, in the public goods setting, it has been widely acknowledged that recognizing contributors by revealing their identity enhances pro-social behavior and increases contributions to public goods (Andreoni and Petrie, 2004; Anderson et al., 2009; Samek and Sheremeta, 2014). However, unlike the public goods setting where increasing one's contribution exerts a positive externality on others, in the contest setting, increasing one's effort imposes a negative externality on others. Despite the clear practical relevance, to the best of our knowledge, there is no other study that examines the impact of social identification on individual behavior in contests. Our study fills this gap by providing clear evidence that social identification (through photo display) decreases wasteful efforts in contests.

Our study also contributes to the literature investigating how feedback about relative performance in contests impacts individual behavior. This has been an area of interest in many workplace settings where feedback about the relative rank can be used strategically to improve employees' performance in organizations (Smither et al., 2005).[1] Kuhnen and Tymula (2012), for

[1] There are also studies that investigate how information feedback impacts auctions and markets. Smith (1991) documents that in continuous double auctions under private information convergence to competitive equilibrium is faster than under complete information. Similarly, Noussair and Porter (1992) report that English and uniform price sealed bid auctions are more efficient when there is a lack of common information. Isaac and Walker (1985) find

example, find that after receiving feedback subjects who rank higher in a deterministic tournament decrease their effort, while subjects who rank lower increase their effort. Similarly, Ludwig and Lünser (2012), document that in a two-stage tournament, contestants who lag behind tend to raise their effort in the second stage, while those who lead tend to reduce their effort. They find that on average there is no significant difference in the total effort between the feedback and the no-feedback treatments. Eriksson et al. (2009) also find that providing information about relative performance does not significantly influence the subjects' average effort. In contrast, some studies find that providing individuals with relative performance feedback increases effort (Blanes i Vidal and Nossol, 2011; Azmat and Iriberri, 2013), while others find that giving subjects additional feedback about rivals' effort reduces aggregate effort (Fallucchi et al., 2013). Unlike most of these studies where a subject who exerts most effort is guaranteed to win, we examine a rent-seeking lottery contest in which subjects exert effort in order to influence the probability of winning.[2] Furthermore, given that evidence is mixed in experiments with deterministic framework, the random component in lottery contests makes it even harder to decipher the precise impact of information feedback on individual and total effort. Our study fills this vacuum by demonstrating that although providing information feedback does not affect the total effort, it decreases the heterogeneity of effort and significantly affects the dynamics of individual behavior in contests.

---

that in auctions, bidding decreases when bidders receive information feedback about all bids. Similarly, Dufwenberg and Gneezy (2002) find that reporting the entire distribution of prices facilitates collusion in a first-price auction. The effect of providing information about group members' decisions has also been studied in the public goods settings (Fischbacher et al., 2001; Harrison and List, 2004; Fischbacher and Gächter, 2006; Kocher et al., 2007; McCarter et al., 2014) and in trust games (Rietz et al., 2013).

[2] The only exception is Fallucchi et al. (2013), who employ a similar type of contest. The difference in findings relative to our study may be attributed to several procedural differences, such as the length of experiment (60 periods versus 20 periods). Furthermore, our study examines how information feedback impacts individual behavior under different social identification protocols whereas their study focuses on the effect of information feedback under different contest structures.

3. Theoretical Model

Our experimental design employs a lottery rent-seeking contest which is based on the theoretical model of Tullock (1980). Almost all popular theories investigating different aspects of contests are based on this seminal model of rent-seeking. The predictions below serve as a benchmark for comparison in our experiment.

In the standard rent-seeking contest, n identical risk-neutral individuals compete for a prize v by exerting efforts. The probability that an individual i wins the prize is equal to individual i's own effort e_i divided by the sum of all individuals' efforts:

$$p_i(e_i, e_{-i}) = \frac{e_i}{\sum_{j=1}^{n} e_j}. \quad (1)$$

The individual's probability of winning increases monotonically in own effort e_i and decreases in the opponents' efforts e_j. Given (1), the expected payoff of a risk-neutral individual i can be written as

$$\pi_i(e_i, e_{-i}) = p_i(e_i, e_{-i})v - e_i. \quad (2)$$

That is, the probability of winning the prize $p_i(e_i, e_{-i})$ times the prize value v minus the cost of effort e_i. Differentiating (2) with respect to e_i and accounting for the symmetric Nash equilibrium leads to a classical solution (Tullock, 1980):

$$e^* = \frac{(n-1)}{n^2}v. \quad (3)$$

In the equilibrium, each individual has an equal probability of winning, i.e., $p(e^*) = 1/n$. The equilibrium expected payoff can be calculated by plugging (3) into (2), which gives

$$\pi(e^*) = \frac{1}{n^2}v. \quad (4)$$

Economic intuition behind this model is straightforward. Higher value of prize v implies higher equilibrium effort e^* and higher payoff $\pi(e^*)$. On the other hand, higher number of

competitors n implies lower equilibrium effort e^* (due to so-called "discouragement effect") and lower payoff $\pi(e^*)$.[3] Note that the Pareto optimal level of effort is zero, i.e., $e = 0$. In such a case, no effort is wasted and each individual still has an equal probability of winning, i.e., $p = 1/n$. Therefore, the classic formulation of a Tullock contest demonstrates the tension between the socially optimal and the individually rational behavior.

Although theoretical predictions characterized by equations (3) and (4) serve as the benchmark for our experiment, it is well documented in the literature that individuals often exert significantly more effort than the Nash equilibrium (Sheremeta, 2013). One explanation for this over-expenditure of effort is that, in addition to the value of the prize v, individuals also have a non-monetary utility of winning w. Therefore, we augment the expected payoff (2) as follows:

$$\pi_i^w(e_i, e_{-i}) = p_i(e_i, e_{-i})(v + w) - e_i. \quad (5)$$

The addition of a non-monetary utility of winning w in (5) is similar to the theoretical models presented in Parco et al. (2005), Amaldoss and Rapoport (2009), and Sheremeta (2010b, 2013).

Furthermore, it can be argued that individuals also care about their payoff relative to others in the group (Frey and Stutzer, 2002). In such a case, the expected utility of individual i includes the weighted average payoff of other group members and can be written as

$$U_i(e_i, e_{-i}) = \pi_i^w(e_i, e_{-i}) + s\frac{1}{n}\sum_j \pi_j^w\left(e_j, e_{-j}\right). \quad (6)$$

The interdependent social payoff parameter s represents a measure of how individuals weight their payoffs relative to others: $s > 0$ reflects preferences of pro-social individuals who strive to increase the payoff of the entire group, while $s < 0$ reflects preferences of status-seeking individuals who strive to obtain a higher relative payoff within the group.[4]

[3] For a more detailed discussion of the "discouragement effect," see Deck and Sheremeta (2012).

[4] The exact origin of s is ambiguous. On the one hand, it may be the case that individuals simply have other-regarding preferences (Fehr and Schmidt, 1999). On the other hand, evolutionary game theory would argue that

Differentiating (6) with respect to e_i and accounting for the symmetric Nash equilibrium gives us the equilibrium effort:

$$e^{ws} = \frac{(n-1)}{n(n+s)}(v+w). \quad (7)$$

The equilibrium effort (7) increases in the non-monetary utility of winning w, i.e., $\frac{\partial e^{ws}}{\partial w} > 0$, and decrease in the social payoff parameter s, i.e., $\frac{\partial e^{ws}}{\partial s} < 0$. To remain consistent with the literature, in the analysis below we will use the equilibrium predictions described in (3) and (4) for benchmark comparisons. We will further explore implications of non-monetary utility of winning and relative payoff maximization contained in (7) when providing behavioral explanations of our results.

4. Experimental Design and Procedures

The experiment was conducted at the Vernon Smith Experimental Economics Laboratory at Purdue University. A total of 240 undergraduate student subjects participated in 12 sessions (3 sessions per treatment), with 20 subjects participating in each session. All subjects participated in only one session of this study. Some subjects had participated in other economics experiments that were unrelated to this research.

The computerized experimental sessions used z-Tree (Fischbacher, 2007) to record subject decisions and display photos of subjects. Upon arriving at the lab, each subject was photographed and then randomly assigned to a computer station. The experiment comprised of playing a lottery contest game for a total of 20 periods with a group of 4 participants. Each subject was randomly assigned to a group of 4 at the beginning of the experiment, and remained

individuals care about their "survival" payoff (Leininger, 2003; Hehenkamp et al., 2004; Riechmann, 2007). Finally, the quest to seek higher expected payoff than others is also consistent with the 'spite effect' (Hamilton, 1970).

matched with the same group members for the duration of the experiment. At the beginning of each period, each subject received an endowment of 80 experimental francs and was asked to make an effort in a lottery contest with a prize valued at 80 experimental francs. To keep the terminology neutral, we avoided the term "effort" and the task was described in the instructions as "choose a bid." Each subject's probability of winning the prize was equal to his/her effort divided by the aggregate effort of all 4 participants in the group.

We conducted four treatments, as in Table 1, using a two-by-two design in which we varied the information feedback ("no information" NI versus "information" I) and the identification of group members ("no photo" NP versus "photo" P). The only difference between the information treatments was the feedback provided to subjects at the end of each period. In the treatments with no information feedback (NP-NI and P-NI), we provided feedback only about the individual's own effort, earnings, and whether she won or not, but did not provide information about the efforts of other group members or the identity of the winner of the contest. In the treatments with information feedback (NP-I and P-I), we assigned each member an ID number (1-4), provided full information about each group member's effort and explicitly revealed (using the ID number) which subject's effort resulted in winning the contest at the end of each period. We varied the degree of social identification by varying whether or not the identities of participants were revealed to fellow group members. In treatments where no identities were revealed (NP-I and NP-NI), we did not provide any identifying information about other members in the group. On the other hand, in treatments P-NI and P-I, we provided photos and first names of each group member.[5]

[5] Before the beginning of the experiment, subjects in the P-NI and P-I treatments were asked to write their first names on a name card, and the experimenter took a photo of each subject holding up the name card. Similar to the designs of Andreoni and Petrie (2004) and Samek and Sheremeta (2014), we chose to use digital photos to identify

At the end of the experiment, 2 out of 20 periods were selected for payment using a random draw from a bingo cage. Experimental francs were used throughout the experiment, with a conversion rate of 15 francs = $1. The experimental earnings, including the $5 participation fee, averaged $18.75, and ranged from a low of $8.25 to a high of $30.00.[6] Sessions (including instruction time) lasted approximately 60-80 minutes. At the end of each session, subjects also completed a single-period game aimed at eliciting their non-monetary utility of winning, and a demographic questionnaire.

5. Results

5.1. Overview

Table 2 summarizes the average efforts and payoffs for all four treatments. In equilibrium, all subjects should exert an effort of 15 and receive a payoff of 5.[7] Similar to related work, however, we find that on average the observed effort in all treatments is significantly greater than predicted (Wilcoxon signed-rank test, all p-values<0.05, n=15), and as a result, the average payoffs are negative.[8] The persistence of over-expenditure is also shown in Figure 1, which displays the average effort over all 20 periods of the experiment. Although there is a declining trend, the average effort remains significantly higher than the Nash equilibrium

subjects to one another because digital photos capture and preserve the appearance of the person but do not allow for communication, which may confound the effects of identification.

[6] Photographing participants in the photo identification treatments took more time, so an additional $5 "surprise show up fee" was added at the end of the experiment in order to comply with the laboratory policies.

[7] According to equation (3), individual effort is $e^* = 80(4-1)/4^2 = 15$, and according to equation (4), expected payoff is $\pi(e^*) = 80/4^2 = 5$.

[8] The non-parametric tests employ each group of four subjects as an independent observation.

prediction. Such significant over-expenditure of effort is consistent with previous findings of contest experiments (Sheremeta, 2013; Dechenaux et al., 2014).[9]

Result 1: In all treatments there is significant over-expenditure of effort relative to the Nash equilibrium prediction.

We also find significant heterogeneity in individual behavior, which is inconsistent with play at a unique pure strategy Nash equilibrium of 15. Figure 2 displays the distribution of the average effort by subject in each treatment. Subjects are sorted in increasing order by the average effort, which is indicated by the solid line. The error bars represent the standard deviations of effort for each subject over all 20 periods. Hence, by focusing on the solid line one can decipher the cumulative empirical distribution of the average effort across subjects (signifying the between-subjects heterogeneity), and by focusing on the error bars one can get a sense of the degree of within-subject heterogeneity. Figure 2 clearly shows that there is a very high degree of both between-subjects and within-subject heterogeneity, which is also consistent with previous findings of contest experiments (Sheremeta, 2013; Dechenaux et al., 2014).

5.2. Social Identification

Examining the impact of social identification, we find that in the treatments in which subjects' photos are revealed (P-NI and P-I), the average effort is 17% lower than when there is no photo identification (NP-NI and NP-I). Combining data from both photo treatments and comparing it to data from no-photo treatments, conservative non-parametric test yield that photo

[9] Some studies that document significant overbidding in contests are done by Davis and Reilly (1998), Potters et al. (1998), Sheremeta (2010a, 2010b, 2011), Sheremeta and Zhang (2010), Price and Sheremeta (2011, 2014), Cason et al. (2010, 2011, 2012), Mago et al. (2013), Savikhin and Sheremeta (2013), and Chowdhury et al. (2014).

display reduces the average effort and the effect is marginally significant (28.7 versus 24.6: Mann-Whitney test, p-value=0.06; n=m=30).[10]

The conservative nonparametric tests are valuable because they require a minimal number of statistical assumptions, and are based on only statistically independent observations. However, they do not control for other factors that could influence results, such as a possibly significant time trend or demographic variables. To support our finding, we report the results of random effects panel regressions in Table 3 where individual subjects represent random effects and standard errors are clustered at the group level. *Effort* is the dependent variable and treatment dummies for whether or not photos were displayed (*Photo*) or additional information was available in that treatment (*Information*) are independent variables. In specification (1), the effort is significantly lower in both treatments where photos are displayed. Furthermore, while *Information* by itself has no impact on the effort level (p-value = 0.79), it does reinforce the downward impact on effort yielded by *Photo*. Specification (2) includes additional demographic characteristics (gender, whether or not the subject is an economics major, and self-reported GPA), which are not significant but they dilute the impact of *Photo*. Therefore, controlling for demographic characteristics, effort is significantly lower only in the treatment where both *Photo* and *Information* dummies are positive.[11] Overall, both parametric and non-parametric tests corroborate our conclusion that identifying subjects through photo display decreases effort.

Result 2: Identifying group members through photo display decreases average effort.

[10] The average effort of 25.1 in P-NI is lower than the average effort of 29.1 in NP-NI, and the average effort of 24.1 in P-I is lower than the average effort of 28.3 in NP-I. However, these pair-wise treatment comparisons are not significant at the conventional level (Mann-Whitney test, p-values=0.14 and 0.24; n=m=15). One reason for the lack of significance is the small sample size. We are purposefully conservative in our non-parametric tests and use the effort averaged over all 20 periods for each separate group as one unit of observation. This yields 15 independent observations per treatment.

[11] Results are similar in alternate specifications that include only *Photo, Identification* and their interaction dummies. These are available from the authors upon request.

Note that time trend is significant in both specifications (in Table 3) and this is also consistent with the declining trend in effort levels reported earlier. Therefore, we also consider how the role of identification differs in early rounds as compared to later rounds (see Figure 1). We find that efforts averaged across the first 5 periods are significantly lower in treatments with identification than without identification (27.3 versus 31.4, Mann-Whitney test, p-value=0.05; n=m=30). However, in later periods 16-20, efforts are not significantly different between treatments with identification and without identification (23.4 versus 25.3, Mann-Whitney test, p-value=0.66; n=m=30). Therefore, while aggregate effort declines in all four treatments, the rate of decline in the photo identification treatments is lower compared to treatments without identification. This implies that the impact of identification on individual behavior in contests is immediate and becomes evident in the early periods of the experiment.

5.3. Information Feedback

Examining the impact of information feedback, we find no significant difference in the average effort levels between treatments where there is information feedback and where there is no information feedback. Combining the data from both information treatments and comparing it to the data from the no-information treatments, we find no significant impact of information on effort (26.7 versus 27.1: Mann-Whitney test, p-value=0.63; n=m=30). Pairwise treatment comparisons between NP-NI versus NP-I and P-NI versus P-I are also not significant.[12]

Although information feedback has no impact on the average effort level, it appears to impact the heterogeneity of effort (see Figure 2). Table 4 provides two different measures of heterogeneity of effort. The *between-subjects* heterogeneity measure in period *t* is calculated as

[12] The average effort of 29.1 in NP-NI is not significantly different from the average effort of 28.3 in NP-I and the average effort of 25.1 in P-NI is not significantly different from the average effort of 24.1 in P-I (Mann-Whitney test, p-values=0.98 and 0.55; n=m=15).

the absolute difference between individual effort and average group effort in period *t*. The *within-subject* heterogeneity measure in period *t* is calculated as the absolute difference between individual effort in period *t* and period *t*-1. The average *between-subjects* heterogeneity measure in the information treatments (NP-I and P-I) is significantly lower than in the no information treatments (NP-NI and P-NI), when comparing all periods (16.0 versus 13.4; Mann-Whitney test, p-value=0.03; n=m=30), as well as the first five periods (15.3 versus 12.8; Mann-Whitney test, p-value=0.05; n=m=30). However, there is no significant difference in the average *within-subject* heterogeneity measure (all p-values>0.5). Therefore, it appears that information feedback does not impact the within-subject heterogeneity, but it does make effort levels more uniform across subjects.

Next, we examine the mechanism through which information influences individual behavior. Table 5 displays a panel regression that measures the impact of different lag variables in period *t*-1 on *Effort* in period *t*. When subjects receive no feedback information about others' efforts (specification 1), we find that the major predictor of individual effort is the *Effort-lag* variable, i.e., their own effort in period *t*-1.[13] The *Effort-lag* variable remains a significant predictor of effort even when subjects receive full feedback about others' efforts (specification 2). In addition, *Above-lag* and *Below-lag* variables are significant in specification (2). The negative and significant *Above-lag* variable indicates that subjects whose effort is higher than the winning effort in period *t*-1 reduce their effort in period *t*; and the positive and significant *Below-lag* variable indicates that subjects whose effort is lower than the winning effort in period *t*-1 increase their effort in period *t*.

[13] Note that in treatments NP-NI and P-NI, subjects actually do not learn whether their effort in *t*-1 was above or below the winning effort. However, the *Above-lag* and *Below-lag* variables in specification (1) are included to facilitate the comparison with specification (2). The estimation results of specification (1) are virtually the same when we exclude these two variables from the estimation of specification (1).

Result 3: Providing information about others' efforts does not have a significant effect on the average effort level, but it decreases the within-subject heterogeneity of effort and significantly affects the dynamics of individual effort.

The dynamics of individual effort can explain several patterns in our data. First, it can explain why we find no significant impact of information on average effort – there are two opposing effects acting simultaneously (i.e., *Above-lag* and *Below-lag*) that on average counterbalance each other. Second, the negative *Above-lag* and positive *Below-lag* variables imply that over time efforts within the group should become more uniform, explaining why information significantly reduces *between-subjects* heterogeneity. Finally, the significant lag variables imply substantial *within-subject* heterogeneity of efforts, which persist over all periods of the experiment. In sum, the results of our experiment clearly indicate that providing information feedback in contests changes the dynamics of individual effort, even though it does not change the aggregate effort.

6. Behavioral Explanations

The main findings of our experiment (Results 1-3) can be explained by a behavioral model which incorporates a non-monetary utility of winning (captured by w) and relative payoff maximization (captured by s). In Section 3, instead of an equilibrium effort (3), i.e., $e^* = \frac{(n-1)}{n^2}v$, we derived an alternative prediction given by (7), i.e., $e^{ws} = \frac{(n-1)}{n(n+s)}(v+w)$.

Non-monetary utility of winning w is not directly observable, but following Sheremeta (2010b) we elicited it as follows: In a 'surprise' additional period at the end of the experiment, all subjects were given an endowment of 80 francs, and participated in a lottery contest for a prize valued at $v = 0$ francs. Subjects were explicitly told that their effort is costly and that the

cost of effort would be subtracted from their earnings. We find that 51% of subjects indicate a non-monetary utility of winning by exerting positive efforts for the prize valued at 0 francs, with about 25% of subjects choosing efforts higher than 10 francs (equivalent to $0.67). Therefore, over-expenditure of effort relative to the Nash equilibrium prediction (Result 1) can be explained by the fact that many subjects have a non-monetary utility of winning, i.e., $w > 0$.

To further analyze the extent to which non-monetary utility of winning affects subjects' efforts, we provide panel regression analysis in Table 6, where the dependent variable is the subject's *Effort* and the independent variables are a *Period* trend, treatment dummy-variables, and their *Non-monetary* effort. Specification (1) indicates a significant and positive correlation between *Effort* and the *Non-monetary* variable.[14] This finding suggests that winning is a component in a subject's utility, and that non-monetary utility of winning may partially explain over-expenditure of effort in contests. The association between non-monetary utility of winning and over-expenditure has been shown in a number of studies (Sheremeta, 2010a, 2010b; Cason et al., 2011; Price and Sheremeta, 2011, 2014; Brookins and Ryvkin, 2014). From the standpoint of our experiment, it is more interesting to note that the non-monetary utility of winning is not impacted by either information about others' efforts or by identification of group members.[15] This suggests that while non-monetary utility of winning w can explain the magnitude of over-expenditure in all treatments, it cannot explain the differences in behavior observed in treatments with and without social identification.

[14] One may argue that the non-monetary utility of winning coefficient is capturing confusion instead of a non-monetary utility of winning. We control for confusion by using the *Quiz* variable that measures the number of correct answers on the quiz, which was administered right after the instructions. Consistent with the intuition, we find that subjects who understand the instructions exert lower efforts, but this result is only marginally significant for the P-I treatment. Despite controlling for confusion, the *Non-monetary* coefficient is positive and significant.

[15] The non-monetary utility of winning is not significantly different across treatments. Efforts for the prize of zero are slightly higher in the no-photo treatments NP-NI and NP-I than in the photo treatments P-NI and P-I (the average of 9.2 versus 7.0), but the difference is not significant (Mann-Whitney test, p-value=0.27; n=m=120). Moreover, all pair-wise treatment comparisons show no significant difference across treatments (Mann-Whitney test, all p-values>0.15; n=m=60).

To explain how social identification (Result 2) and information feedback (Result 3) impact individual behavior, we include the interdependent social payoff parameter s in the expected utility function. s is a measure of how individuals weigh their payoffs relative to others, or in other words, it reflects a degree of 'social distance' between group members.[16] Since s is not directly measurable, we first derive from equation (7) the effort e_0^{ws} that symmetric contestants, having a non-monetary utility of winning w, should exert in a contest with the prize of zero (i.e., $v = 0$):

$$e_0^{ws} = \frac{(n-1)}{n(n+s)}w. \tag{8}$$

Next from equations (7) and (8) we can derive the value of s:

$$s = \frac{(n-1)}{n(e-e_0^{ws})}v - n. \tag{9}$$

Using the observed average effort e for the prize of 80 francs and the effort e_0^{ws} for the prize of 0 francs, we estimate the value of s for each subject. Upon calculating individual-specific s for each subject, we find that 67% of subjects behave as status-seekers (i.e., $s < 0$) and only 33% of subjects are pro-social (i.e., $s > 0$). Therefore, the majority of subjects behave as if they are relative payoff maximizers (or status-seekers), i.e., they maximize the difference between their own payoff and weighted payoffs of other group members.[17] Next, we discuss how social identification and information feedback may impact *s*, and consequently the individual behavior in contests.

Social Identification: A decrease in 'social distance' increases the value of the social payoff parameter *s*, and according to our behavioral model should decrease efforts in the contest.

[16] Hoffman et al. (1996, pg. 654) define social distance to be the "degree of reciprocity that subjects believe exist within a social interaction."

[17] Such relative payoff maximization can also provide an equilibrium explanation for the observed over-expenditure (Leininger, 2003; Hehenkamp et al., 2004).

Revealing individual identities is one way to reduce social distance between the individual and other members in the group and induce pro-social behavior (Andreoni and Petrie, 2004; Rege and Telle, 2004; Samek and Sheremeta, 2014).[18] Indeed, we find that the median value of the social payoff parameter *s* is higher in the photo treatments than in the no-photo treatments (-1.15 versus -1.48), suggesting that social identification through photo display decreases social distance between group members. Consistent with the prediction that decrease in social distance reduces over-expenditure of efforts, we find that the average effort of 24.6 in the photo treatments (P-NI and P-I) is lower than the average effort of 28.7 in the no-photo treatments (NP-NI and NP-I).

Information Feedback: Information about others' efforts can give rise to regret. The basic concept of regret, analyzed by Engelbrecht-Wiggans and Katok (2007, 2008) in the first price auction, is that the winner of the auction may regret paying too much relative to the second highest bid (winner regret) and the loser may regret missing a profitable trade opportunity by bidding too low (loser regret). Similar rationale holds true in contests, and regret theory predicts that effort should decrease in winner regret (analogous to higher *s*) and increase in loser regret (analogous to lower *s*). Since winner and loser regret affects effort in diametrically opposite ways and the equilibrium effort level depends on the relative weight of each type of regret, the precise effect of full information disclosure on social payoff parameter *s* cannot be predicted *a priori* (Engelbrecht-Wiggans and Katok, 2009). In our data, we find that the median value of the social payoff parameter *s* is similar across the two information treatments (-1.34 versus -1.25). However, as documented earlier (see Table 5), we find that both the *Above-lag* (can be

[18] Eckel and Petrie (2011) attribute this in part to the association of attractiveness and skin tone with expectations about a partner's behavior. Another potential explanation of why photo display enhances pro-social behavior is based on group social identity theory (Tajfel and Turner, 1979; Ahmed, 2007; Chen and Li, 2009). In addition to revealing identities, in related work Scharlemann et al. (2001) find that "smiles" can elicit cooperation among strangers in a one-shot bargaining interaction.

interpreted as the winner regret) and *Below-lag* (can be interpreted as the loser regret) variables are significant. This helps explain why information feedback makes no difference to the average effort level, but reduces the between-subjects heterogeneity of effort.[19] In this regard, our results are consistent with the experimental test of regret theory by Engelbrecht-Wiggans and Katok (2008).[20]

In summary, the behavioral model that incorporates a non-monetary utility of winning and relative payoff maximization can explain our data. Replicating other studies (e.g., Sheremeta, 2010a, 2010b; Price and Sheremeta, 2011, 2014) we find that non-monetary utility of winning can explain the significant over-expenditure of effort (Result 1). However, it cannot explain differences across treatments. The treatment effects, can be explained by relative payoff maximization. The latter can explain both why social identification through photo display decreases the average effort (Result 2) and why improved information feedback reduces the between-subjects heterogeneity of effort (Result 3).

7. Conclusion

What happens to competitive behavior in contests when identities of other participants and information about their effort are revealed? Does such information increase or decrease individual effort? Does it change the dynamics of group effort? To answer these questions, we conduct a laboratory experiment in which we investigate the effect of social identification and information feedback on individual behavior in contests. In all treatments, we find significant

[19] Full information feedback can also facilitate faster learning of the incentives inherent in the contest structure. When information about all individual efforts is public knowledge, subjects may learn about profitable strategies more quickly from the experience of others, and this also reduces the between-subjects heterogeneity of effort, as evident in our data.

[20] By manipulating information feedback, they find evidence of both winner regret and loser regret. However, they find that no difference in bid levels when there is complete information on both winner and loser regret compared to when there is no information about other participants' bid levels.

over-expenditure of effort relative to standard theoretical predictions. Identifying subjects through photo display decreases wasteful effort. Providing information feedback about others' effort does not affect aggregate effort but it decreases the heterogeneity of effort and significantly affects the dynamics of individual behavior. A behavioral model that incorporates non-monetary utility of winning and relative payoff maximization explains significant over-expenditure of effort. The model also suggests that decrease in social distance between group members through photo display promotes pro-social behavior and decreases over-expenditure of effort, while improved information feedback reduces the between-subjects heterogeneity of effort.

Knowing the opponents' identities and effort levels are important design features that can influence individual behavior in practice (Smither et al., 2005). Examples of practical applications include college admissions, workplace promotions, patent races, political lobbying and competition for monopolistic rents. Our results suggest that explicitly identifying contestants may decrease social distance between group members and decrease wasteful over-expenditure of effort. Providing information feedback about others' efforts may change the dynamics of individual behavior, although it may not change the aggregate effort.

Our results contribute to several areas of research. First, our study contributes to the discussion of why there is over-expenditure of efforts in contests (Sheremeta, 2013). Over the past decade, a number of studies have offered various explanations such as mistakes (Potters et al., 1998; Sheremeta, 2011), judgmental biases and non-monotonic probability weighting (Amaldoss and Rapoport, 2009; Kalra and Shi, 2010). Our findings suggest that over-expenditure in contests can also be explained by a combination of a non-monetary utility of

winning and relative payoff maximization. Moreover, we find that such over-expenditure can be reduced by identifying participants through photo display.

Our study also contributes to a growing literature on the role of social identification on economic behavior. Similar to related work that finds an increase in trust (Eckel and Wilson, 2006), pro-social contributions to the public good (Andreoni and Petrie, 2004; Samek and Sheremeta, 2014) or cooperation (Bohnet and Frey, 1999a, 1999b; Burnham, 2003), we find that identification decreases the externality on others in the group through a decrease in wasteful over-expenditure of effort. Our findings regarding the role of information feedback in rent-seeking contests complement some of the recent work in this area, e.g., real-effort tasks in Kuhnen and Tymula (2012) and tournament play in Eriksson et al. (2009). Our result that information feedback about others' efforts reduces between-subject heterogeneity would be relevant to scenarios where the social planner is interested in promoting equity.

There are many avenues for future research. Given the strong impact of social recognition on individual behavior, it would be interesting to investigate other settings by varying the degree of social consciousness of players. One way to do this is to introduce asymmetric endowments. When endowments are asymmetric, the effect of displaying photos may be stronger as players with greater endowment may feel more conscious about exerting higher effort and thus imposing higher negative externality on their team members. Also, it is important to examine how individuals would self-select into alternative contests, knowing that their identities may be revealed. On the one hand, the results of our experiment indicate that in treatments with revealed identities subjects exert significantly lower efforts and thus earn higher payoffs. On the other hand, subjects may be averse to having their identities revealed and thus may avoid more profitable but less "private" contests. We leave these questions for future research.

References

Amaldoss, W., & Rapoport, A. (2009). Excessive expenditure in two-stage contests: Theory and experimental evidence. In F. Columbus (Ed.), Game Theory: Strategies, Equilibria, and Theorems. Hauppauge, NY: Nova Science Publishers.

Andreoni, J., & Petrie, R. (2004). Public goods experiments without confidentiality: a glimpse into fund-raising. Journal of Public Economics, 88, 1605-1623.

Azmat, G., & Iriberri, N. (2013). The Provision of Relative Performance Feedback: An Analysis of Performance and Satisfaction. Working Paper.

Blanes i Vidal, J., & Nossol, M. (2011). Tournaments without prizes: evidence from personnel records. Management Science, 57, 1721-1736.

Bohnet, I., & Frey, B.S. (1999a). Social Distance and Other-Regarding Behavior in Dictator Games: Comment. American Economic Review, 89, 335-339.

Bohnet, I., & Frey, B.S. (1999b). The sound of silence in prisoner's dilemma and dictator games. Journal of Economic Behavior and Organization, 38, 43-57.

Brookins, P., Ryvkin, D. (2014). An experimental study of bidding in contests of incomplete information. Experimental Economics, 17, 245-261.

Bull, C., Schotter, A., & Weigelt, K., (1987). Tournaments and piece rates: an experimental study. Journal of Political Economy, 95, 1-33.

Burnham, T.C. (2003). Engineering altruism: a theoretical and experimental investigation of anonymity and gift giving. Journal of Economic Behavior and Organization, 50, 133-144.

Cason, T.N., Masters, W.A. & Sheremeta, R.M. (2010). Entry into Winner-Take-All and Proportional-Prize Contests: An Experimental Study. Journal of Public Economics, 94, 604-611.

Cason, T.N., Masters, W.A. & Sheremeta, R.M. (2011). Winner-Take-All and Proportional-Prize Contests: Theory and Experimental Results. Chapman University, ESI Working Paper.

Cason, T.N., Sheremeta, R.M., & Zhang, J. (2012). Communication and Efficiency in Competitive Coordination Games. Games and Economic Behavior, 76, 26-43.

Chowdhury, S.M., Sheremeta, R.M., & Turocy, T.L. (2014). Overbidding and Overspreading in Rent-Seeking Experiments: Cost Structure and Prize Allocation Rules. Games and Economic Behavior, 87, 224-238.

Davis, D., & Reilly, R. (1998). Do Many Cooks Always Spoil the Stew? An Experimental Analysis of Rent Seeking and the Role of a Strategic Buyer. Public Choice, 95, 89-115.

Dechenaux, E., Kovenock, D., & Sheremeta, R.M. (2014). A Survey of Experimental Research on Contests, All-Pay Auctions and Tournaments. Experimental Economics, forthcoming.

Deck, C., & Sheremeta, R.M. (2012). Fight or flight? Defending against sequential attacks in the game of siege. Journal of Conflict Resolution, 56, 1069-1088.

Dufwenberg, M., & Gneezy, U. (2002). Information Disclosure in Auctions: An Experiment. Journal of Economic Behavior and Organization, 48, 431-444.

Eckel, C., & Wilson, R. (2006). Internet cautions: Experimental games with internet partners. Experimental Economics, 9, 53-66.

Engelbrecht-Wiggans, R., & Katok, E. (2007). Regret in Auctions: Theory and Evidence. Economic Theory, 33, 81-101.

Engelbrecht-Wiggans, R., & Katok, E. (2008). Regret and Feedback Information in First-Price Sealed-Bid Auctions. Management Science, 54, 808-819.

Engelbrecht-Wiggans, R., & Katok, E. (2009). A Direct Test of Risk Aversion and Regret in First Price Sealed-Bid Auctions. Decision Analysis, 6, 75-86.
Fallucchi, F., Renner, E., & Sefton, M. (2013). Information feedback and contest structure in rent-seeking games. European Economic Review, 64, 223-240.
Fehr, E., & Schmidt, K. (1999). A Theory of Fairness, Competition, and Cooperation. Quarterly Journal of Economics, 114, 817–868.
Fischbacher, U. (2007). z-Tree: Zurich Toolbox for Ready-Made Economic Experiments. Experimental Economics, 10, 171-178.
Frey, B.S., & Stutzer, A. (2002). What can economists learn from happiness research? Journal of Economic literature, 40, 402-435.
Gürtler, O., & Harbring, C. (2010). Feedback in Tournaments under Commitment Problems: Experimental Evidence. Journal of Economics and Management Strategy, 19, 771-810.
Hamilton, W.D. (1970). Selfish and spiteful behavior in evolutionary model. Nature, 228, 1218-1220.
Harbring, C., Irlenbusch, B., Krakel, M., & Selten, R. (2007). Sabotage in Corporate Contests – An Experimental Analysis. International Journal of the Economics of Business, 14, 367-392.
Hehenkamp, B., Leininger, W., & Possajenikov, A. (2004). Evolutionary equilibrium in Tullock contests: spite and overdissipation. European Journal of Political Economy, 20, 1045-1057.
Hoffman, E., McCabe, K., & Smith, V. (1996). Social Distance and Other-Regarding Behavior in Dictator Games. American Economic Review, 86, 653-660.
Isaac, R., & Walker, J.M. (1985). Information and Conspiracy in Sealed-Bid Auctions. Journal of Economic Behavior and Organization, 6, 139-159.
Kalra, A., & Shi, M. (2010). Consumer Value Maximizing Sweepstakes and Contests. Journal of Marketing Research, 47, 287-300.
Kuhnen, C.M., & Tymula, A. (2012). Feedback, self-esteem and performance in organizations. Management Science, 58, 94-113.
Leininger, W. (2003). On evolutionarily stable behavior in contests. Economics of Governance, 4, 177-186.
Ludwig, S., & Lunser, G.K. (2012). Observing your competitor – The role of effort information in two-stage tournaments. Journal of Economic Psychology, 33, 166-182.
Mago, S.D., Sheremeta, R.M. & Yates, A. (2013). Best-of-Three Contest Experiments: Strategic versus Psychological Momentum. International Journal of Industrial Organization, 31, 287-296.
McCarter, M.W., Samak, A.C., & Sheremeta, R.M. (2014). Divided Loyalists or Conditional Cooperators? A Study of Cooperation when Facing Multiple Social Dilemmas. Working Paper.
Millner, E.L., & Pratt, M.D. (1989). An Experimental Investigation of Efficient Rent-Seeking. Public Choice, 62, 139-151.
Noussair, C., & Porter, D. (1992). Allocating Priority with Auctions: An Experimental Analysis. Journal of Economic Behavior and Organization, 19, 169-195.
Parco, J. E., Rapoport, A., & Amaldoss, W. (2005). Two-stage contests with budget constraints: An experimental study. Journal of Mathematical Psychology, 49, 320-338.
Potters, J.C., De Vries, C.G., & Van Winden, F. (1998). An Experimental Examination of Rational Rent Seeking. European Journal of Political Economy, 14, 783-800.
Price, C.R., & Sheremeta, R.M. (2011). Endowment Effects in Contests. Economics Letters, 111, 217-219.

Price, C.R., & Sheremeta, R.M. (2014). Endowment Origin, Demographic Effects and Individual Preferences in Contests. Journal of Economics and Management Strategy, forthcoming

Riechmann, T. (2007). An analysis of rent-seeking games with relative-payoff maximizers. Public Choice, 133, 147-155.

Rietz, T. A., Sheremeta, R.M., Shields, T.W., & Smith, V.L. (2013). Transparency, efficiency and the distribution of economic welfare in pass-through investment trust games. Journal of Economic Behavior and Organization, 94, 257-267.

Samek, A.S., & Sheremeta, R.M. (2014). Recognizing contributors: an experiment on public goods. Experimental Economics, forthcoming.

Savikhin, A.S., & Sheremeta, R.M. (2013). Simultaneous Decision-Making in Competitive and Cooperative Games. Economic Inquiry, 51, 1311-1323.

Scharlemann, J.P., Eckel, C.C., Kacelnik, A., & Wilson, R.K. (2001). The value of a smile: Game theory with a human face. Journal of Economic Psychology, 22, 617-640.

Sheremeta, R.M. (2010a). Expenditures and Information Disclosure in Two-Stage Political Contests. Journal of Conflict Resolution, 54, 771-798.

Sheremeta, R.M. (2010b). Experimental Comparison of Multi-Stage and One-Stage Contests. Games and Economic Behavior, 68, 731-747.

Sheremeta, R.M. (2011). Contest Design: An Experimental Investigation. Economic Inquiry, 49, 573-590.

Sheremeta, R.M. (2013). Overbidding and Heterogeneous Behavior in Contest Experiments. Journal of Economic Surveys, 27, 491-514.

Sheremeta, R.M., & Zhang. J. (2010). Can Groups Solve the Problem of Over-Bidding in Contests? Social Choice and Welfare, 35, 175-197.

Smith, V.L. (1991). Papers in Experimental Economics, New York: Cambridge University Press.

Smither, J.W., London, M., & Reilly, R.R. (2005). Does performance improve following multisource feedback? A theoretical model, meta-analysis, and review of empirical findings. Personnel Psychology, 58, 33-66.

Tullock, G. (1980). Efficient Rent Seeking. In J.M. Buchanan, R.D. Tollison, G. Tullock, (Eds.), Toward a theory of the rent-seeking society. College Station, TX: Texas A&M University Press, pp. 97-112.

Tables and Figures

Table 1: Summary of Treatments

Varying Information ⇒ Varying Identification ⇓	No Information (only own effort)	Information (all group members' efforts)
No Photo (identities not revealed)	No Photo, No Information (NP-NI) 3 sessions (60 subjects)	No Photo, Information (NP-I) 3 sessions (60 subjects)
Photo (identities revealed)	Photo, No Information (P-NI) 3 sessions (60 subjects)	Photo, Information (P-I) 3 sessions (60 subjects)

Table 2: Average Effort and Payoff

Treatment	Nash	NP-NI	NP-I	P-NI	P-I
Effort, e^*	15	29.1 (0.7)	28.3 (0.7)	25.1 (0.6)	24.1 (0.6)
Payoff, $\pi(e^*)$	5	-9.1 (0.9)	-8.3 (1.0)	-5.1 (1.0)	-4.1 (1.0)

Standard error of the mean in parentheses.

Table 3: Panel Estimation of Treatment Effects

Dependent variable, *Effort*	All	All
Specification	(1)	(2)
Photo = 1 and *Information* = 1	-5.031**	-5.027*
[dummy variable]	(2.470)	(2.860)
Photo = 1 and *Information* = 0	-4.015*	-4.341
[dummy variable]	(2.441)	(2.821)
Photo = 0 and *Information* = 1	-0.785	-0.543
[dummy variable]	(2.929)	(3.339)
Period	-0.327***	-0.309***
[period trend]	(0.0703)	(0.0746)
Gender		-0.679
[1 if female]		(1.546)
Major		2.695
[1 if econ/business major]		(1.900)
GPA		-1.648
[self-reported GPA]		(1.742)
Constant	32.55***	37.04***
	(1.795)	(5.953)
Observations	4800	4400
Number of subjects	240	220

* significant at 10%, ** significant at 5%, *** significant at 1%. The standard errors in parentheses are clustered at the group level. All models include a random effects error structure, with the individual subject as the random effect, to account for the multiple decisions made by individual subjects. Note that the difference in the number of subjects between specifications 1 and 2 is because we are missing gender information for 20 subjects due to a failure of the demographic questionnaire in that session.

Table 4: Between-Subjects and Within-Subject Heterogeneity of Effort

Treatment	NP-NI	NP-I	P-NI	P-I
	Between-Subjects Heterogeneity Measure			
Periods 1-5	16.5 (0.65)	14.1 (0.62)	14.1 (0.62)	11.5 (0.53)
Periods 16-20	18.1 (0.71)	16.0 (0.69)	14.7 (0.66)	12.9 (0.62)
Periods 1-20	18.1 (0.35)	14.7 (0.33)	13.87 (0.31)	12.0 (0.29)
	Within-Subject Heterogeneity Measure			
Periods 1-5	15.6 (1.21)	15.7 (1.03)	14.1 (1.11)	13.2 (1.03)
Periods 16-20	9.17 (0.97)	16.9 (1.28)	13.8 (1.19)	13.3 (1.15)
Periods 1-20	14.2 (0.59)	16.0 (0.56)	13.9 (0.53)	13.6 (0.50)

Standard error of the mean in parentheses. When calculating the within-subject heterogeneity measure one period is omitted because of the lag variable.

Table 5: Panel Estimation of Determinants of Effort (Lags)

Dependent variable, *Effort*	NP-NI and P-NI	NP-I and P-I
Specification	(1)	(2)
Photo = 1	-1.68	-2.27
[dummy variable]	(1.31)	(1.67)
Effort-lag	0.49***	0.50***
[own effort in *t*-1]	(0.05)	(0.04)
Win-lag	1.79	-1.61
[own win in *t*-1]	(2.52)	(1.88)
Above-lag	-1.51	-4.35***
[1 if above the winning effort in *t*-1]	(2.65)	(1.65)
Below-lag	2.67	5.34***
[1 if below the winning effort in *t*-1]	(2.58)	(1.88)
Period	-0.25***	-0.19**
[period trend]	(0.07)	(0.07)
Constant	15.43***	14.95***
	(3.04)	(3.30)
Observations	2,280	2,280

* significant at 10%, ** significant at 5%, *** significant at 1%. The standard errors in parentheses are clustered at the group level. All models include a random effects error structure, with the individual subject as the random effect, to account for the multiple decisions made by individual subjects.

Table 6: Panel Estimation of Determinants of Effort (Non-Monetary)

Dependent variable, *Effort*	All	NP-NI	NP-I	P-NI	P-I
Specification	(1)	(2)	(3)	(4)	(5)
Photo = 1	-3.76**				
[dummy variable]	(1.92)				
Information = 1	-0.37				
[dummy variable]	(1.91)				
Non-monetary	0.21***	0.26***	0.28*	0.20***	0.08
[effort for prize 0]	(0.05)	(0.07)	(0.14)	(0.05)	(0.13)
Period	-0.33***	-0.50***	-0.27	-0.25**	-0.29**
[period trend]	(0.07)	(0.10)	(0.20)	(0.11)	(0.14)
Quiz	-1.56	-0.19	-3.95	-0.69	-2.26*
[# correct answers on the quiz]	(1.11)	(2.89)	(2.86)	(1.72)	(1.20)
Constant	37.25***	32.42**	46.52***	29.21***	36.44***
	(5.55)	(13.18)	(14.76)	(7.74)	(5.85)
Observations	4,800	1,200	1,200	1,200	1,200

* significant at 10%, ** significant at 5%, *** significant at 1%.

The standard errors in parentheses are clustered at the group level. All models include a random effects error structure, with the individual subject as the random effect, to account for the multiple decisions made by individual subjects.

Figure 1: Average Effort by Treatments

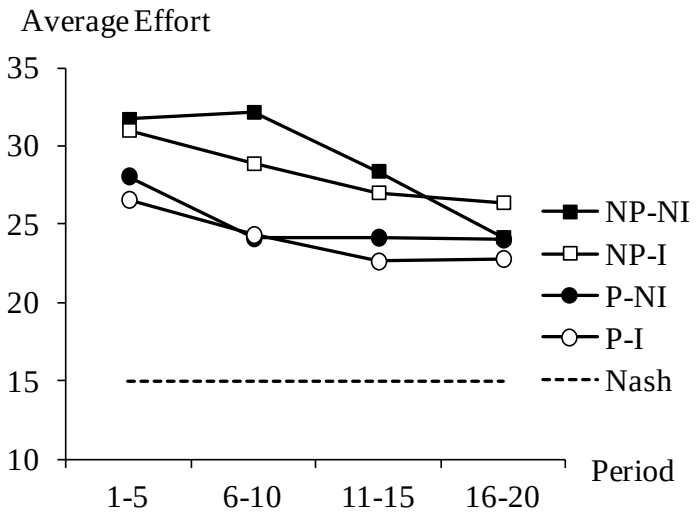
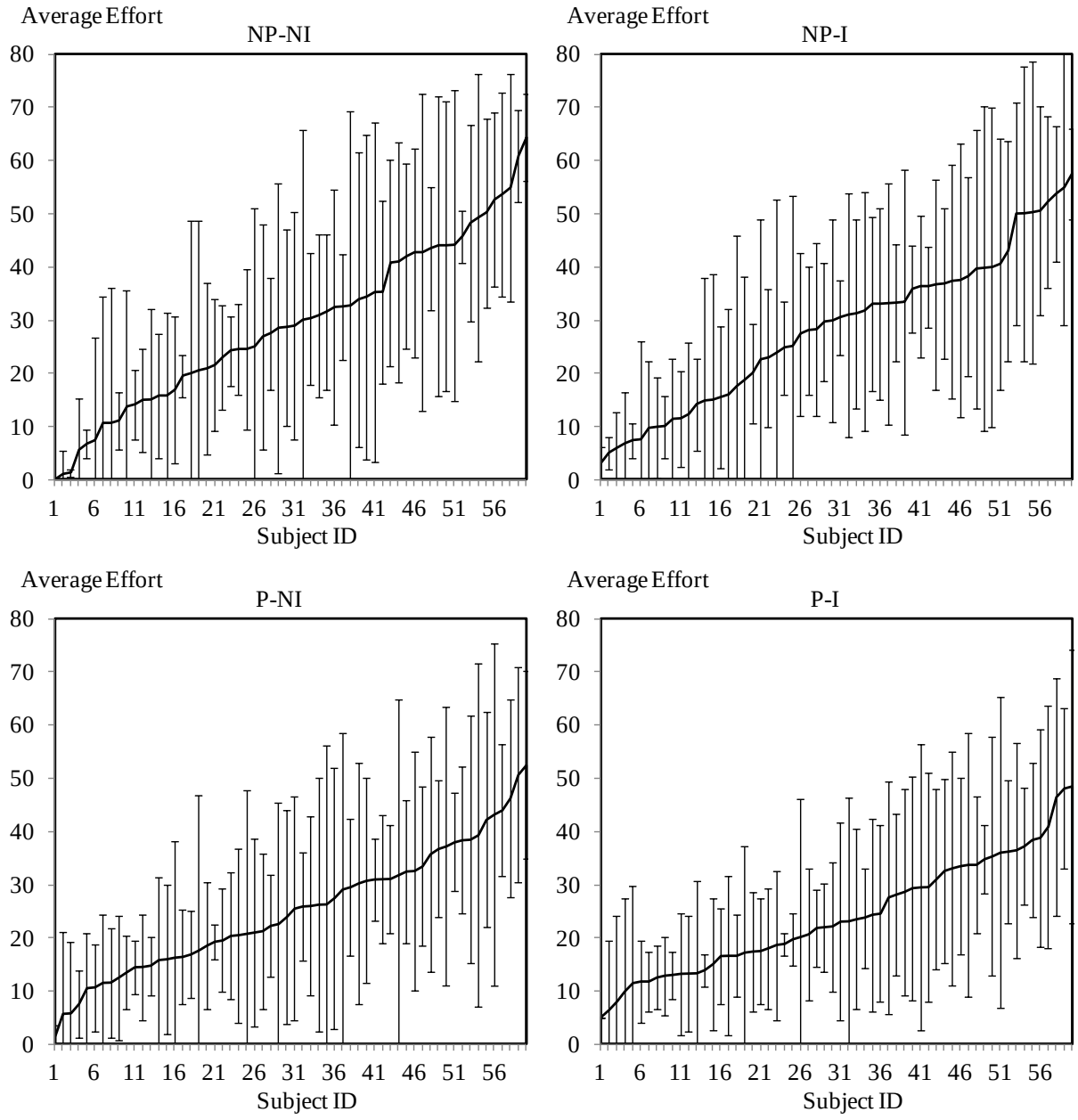


Figure 2: Distribution of the Average Effort by Subject in Each Treatment

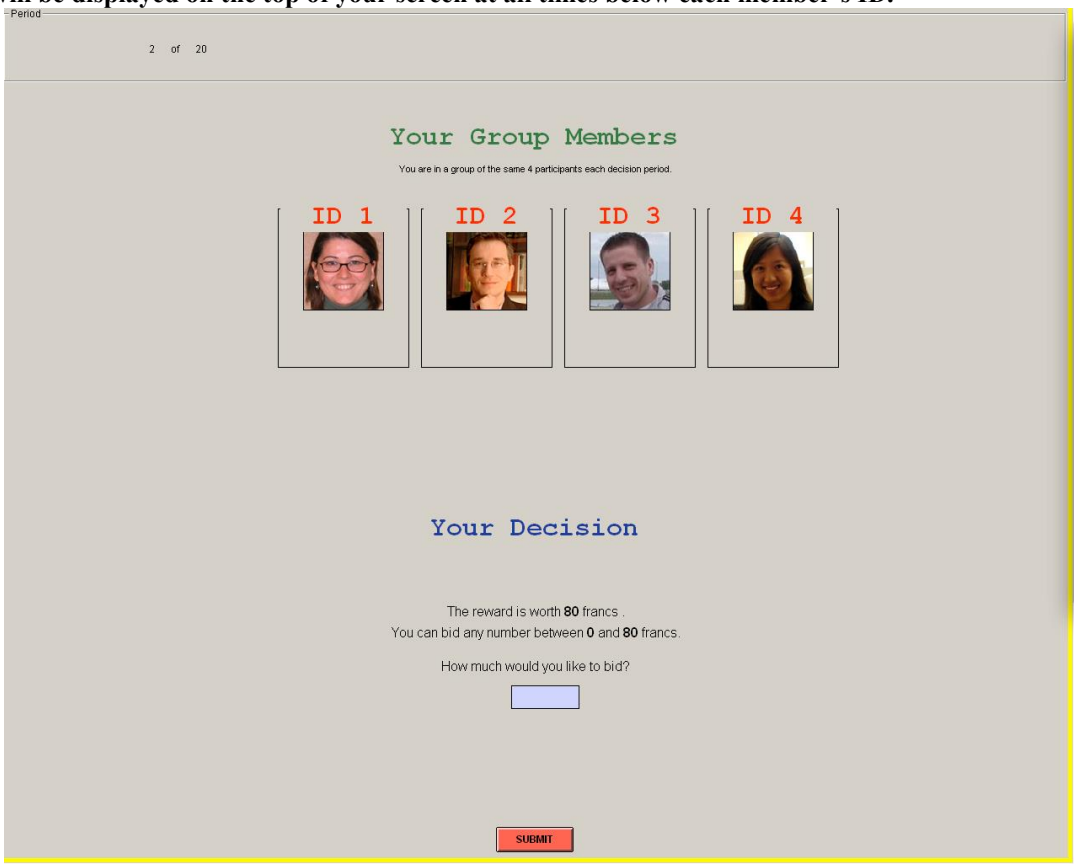


Appendix (For Online Publication Only) – Instructions for P-I Treatment

In this experiment you will be placed in a group of **4 participants** (including you). You will remain in the same group for the entire experiment. The experiment will consist of **20 periods**. At the end of the experiment **2 out of 20** periods will be randomly selected for payment. After you have completed all periods two tokens will be randomly drawn out of a bingo cage containing tokens numbered from **1 to 20**. The token numbers determine which two periods are going to be paid in the game.

Each period you will be given **80 francs.** Francs will be converted to U.S. dollars at the end of the experiment at the rate of **15 francs = $1.** Each period, you will select a bid.

Each group member will receive a randomly chosen ID for the experiment (a number from 1 to 4). Your ID will remain the same for the entire experiment. The photos and names of each member of your group will be displayed on the top of your screen at all times below each member's ID.



Each period, you and all other participants will be given an initial endowment of **80** francs and you will be asked to decide how much you want to bid for **a reward**. The reward is worth **80** francs to you and the other four participants in your group. You may bid any integer number of francs between **0** and **80**. After all participants have made their decisions, your earnings for the period are calculated. These earnings will be converted to cash and paid at the end of the experiment if the current period is the period that is randomly chosen for payment. If you receive the reward your period earnings are equal to your endowment plus the reward minus your bid. If you do not receive the reward your period earnings are equal to your endowment minus your bid.

If you receive the reward: Earnings = Endowment + Reward – Your Bid = 80 + 80 – Your Bid
If you do not receive the reward: Earnings = Endowment – Your Bid = 80 – Your Bid

The more you bid, the more likely you are to receive the reward. The more the other participants in your group bid, the less likely you are to receive the reward. Specifically, for each franc you bid you will receive one lottery ticket. At the end of each period the computer **draws randomly** one ticket among all the tickets purchased by **4 participants** in the group, including you. The owner of the drawn ticket receives the reward of 80 francs. Thus, your chance of receiving the reward is given by the number of francs you bid divided by the total number of francs

all 4 participants in your group bid. You can never guarantee yourself the reward. However, by increasing your bid, you can increase your chance of receiving the reward. Regardless of who receives the reward, all participants will have to pay their bids.

$$\text{Chance of receiving the reward} = \frac{\text{Your Bid}}{\text{Sum of all 4 Bids in your group}}$$

In case all participants bid zero, the reward is randomly assigned to one of the 4 participants in the group.

Example: Let's say participant 1 bids 10 francs, participant 2 bids 15 francs, participant 3 bids 0 francs, and participant 4 bids 40 francs. Therefore, the computer assigns 10 lottery tickets to participant 1, 15 lottery tickets to participant 2, 0 lottery tickets to participant 3, and 40 lottery tickets for participant 4. Then the computer randomly draws **one lottery ticket out of 65** (10 + 15 + 0 + 40). As you can see, participant 4 has the **highest chance** of receiving the reward: **0.62 = 40/65.** Participant 2 has **0.23 = 15/65** chance, participant 1 has **0.15 = 10/65** chance, and participant 3 has **0 = 0/65** chance of receiving the reward.

After all participants make their bids, the computer will make a random draw which will decide who receives the reward. Then the computer will calculate your period earnings based on your bid and whether you received the reward or not.

OUTCOME SCREEN

At the end of each period, your bid, whether you received the reward or not, and your earnings for the period are reported on the outcome screen as shown below. Once the outcome screen is displayed you should record your results for the period on your **Personal Record Sheet** under the appropriate heading.

In addition, you will see the bids of your group members by their ID numbers and whether they received the reward. The photos and names of all your group members will also be displayed on the outcome screen above their IDs.