TWO FREE-RIDER-ACCEPTING METHODS OF ORGANIZING GROUPS FOR A BUSINESS GAME

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ABSTRACT

Based upon the proposition that free riding should be accepted amorally as a law of nature to which participants of a business game ought to be attuned, we devised two methods of organizing groups for a business game. One method initially assigns participants to single-person groups; the other method initially assigns them to an all-inclusive group. Both methods include unlimited opportunities for any participant to switch to any group whose membership is below the smallest preferred size of its members. We involved 60 participants in a design-science study of the two methods to test workability. For both methods, we found that 40% of the participants switched groups and that the participants behaved rationally by taking group size into account in their group-membership decisions. Neither method is favored over the other. Random assignment to both methods is suggested to raise the proportion of participants who will be presented with the free-rider issue and simultaneously empowered to resolve it. Amoral treatment of free-riding may suggest networking principles that have application beyond business games.

INTRODUCTION

A basic concern in administering any business game is deciding how participants should be organized for play. Should they play the game solo, which permits each participant to be fully accountable for the participant's score, or should they play in groups, which allows for risk reduction, synergy, peer-to-peer learning, and other social rewards? If they are to play in groups, should they be assigned to the groups or should they be allowed to form their own groups? After the groups are formed, should the groups be allowed to change their membership? If the groups are allowed to change their membership, what procedure should be followed? The answers are not obvious, for groups are a social arrangement as well as a working arrangement, accompanied by all the vagaries of human relationships.

Our investigation into these questions follows a recent study by Thavikulwat and Chang (2010), which shows that assigning participants to groups of varying sizes based on the participants' expressed preferred group size is workable and advantageous. In their approach, participants at registration select a preferred group size that is used immediately to assign each participant to a group composed of others who have likewise selected the same preferred group size. After this initial assignment, participants each have one opportunity to switch from their assigned group to a single-person group or to another group whose membership is below the smallest preferred size of its members. The process is automated by a computer program, so the procedure is strictly followed, without administrative involvement in the process.

Thavikulwat and Chang's (2010) preferred-size assignment plus one opportunity to switch procedure (PS+1) gives rise to two issues. First, PS+1 disadvantages those who register later, because later registrants are less likely than earlier registrants to be assigned to a group whose size matches their preferences. Second, PS+1 disadvantages those who prefer a larger-size group, because those preferring larger-size groups also are less likely than those preferring smaller-size groups to be assigned to a group whose size matches their preferences. These issues are avoided by two alternative procedures: assigning each participant to a single-person group and assigning all participants to one all-inclusive group. If both alternative procedures are followed by unlimited opportunities for any participant to switch to any group whose membership is below the smallest preferred size of its members, then both alternatives avoid the capriciousness of PS+1 in the initial assignment and both alternatives increase participant control over group membership afterwards. As a consequence, both alternatives solidify the causal relationship between participants' actions and their scores in the game. The single-person assignment plus unlimited opportunity to switch procedure (SP++) and the all-inclusive assignment plus unlimited opportunity to switch procedure (AI++) should therefore be better than PS+1.

This study assesses the workability of SP++ and AI++

by examining the extent to which participants behave rationally under the two conditions, based on the proposition that the conditions are workable if participant conduct conforms with rational expectations. In the discussion that follows, we briefly review the literature on the organization of participants for business games, analyze how rational participants should act under SP++ and AI++, and examine the extent to which our analysis fits the behavior of participants engaged in a business game. The discussion concludes by considering the implications of our findings for the design and administration of business games.

LITERATURE REVIEW

The starting point of research into the organization of participants for business games may be the study by Wolfe and Chacko (1983), which placed participants into group of 1, 2, 3, and 4 participants for a business game in a senior-level business policy class. The study found that groups of 3 yield better results than groups of 1 and 2, but not significantly better than groups of 4. The study's finding is generally consistent with the observations of others, who recommend that group sizes should be kept below 4, 5, or 6 (Biggs, 1986; Brozik, Cassidy, & Brozik, 2008; Cassidy & Brozik, 2009; Fritzsche & Cotter, 1990; Gentry, 1980; Wilson, 1974), because the problem of some participants free riding on the efforts of other participants increases with the size of the group. Even so, Wolfe and McCoy (2011) report that 38.2% of undergraduates assigned to three-member groups in an introductory-level top-management business game were almost completely unengaged in game activities. Likewise, Hornaday (2001) reports in a study where 84% of the groups had three members that 27% of the groups were troubled by free riders. Thus, the problem of free riding is serious even in groups as small as three.

A classical issue in economics harking back to Adam Smith (1776/1909/1937), free riding is related to social loafing (Latané, Williams, & Harkins, 1979), a psychological phenomenon that has been studied extensively since the seminal work of Ringelmann in 1907, as described by Kravitz and Martin (1986). Economists have explicated the logic of free riding to the point of proving that the free-riding problem generally is impossible to resolve without sub-optimizing the outcome of the group when participation is voluntary and the outcome depends completely on members' contributions (Gibbard, 1973; Green & Laffont, 1977). This impossibility finding is weakened when group members have access to independent information about their members' psychological states, which might be obtained through subjecting members to the functional magnetic resonance imaging of their brains (Krajbich, Camerer, Ledyard, & Rangel, 2009), or more practically, through private communications, behavioral cues, and members' previous experiences with each other (Rand, Dreber, Ellingsen, Fudenberg, & Nowak, 2009). In light of these findings, the use of peer evaluations to control and compensate for free riding, recommended by some (Hall & Ko, 2006; Malik & Strang, 1998; Morse, 2002; Payne & Whittaker, 2005; Poon, 2002) and discouraged by others (Morse (2003; Vo, 1982), may be at best a salve, for the logical paradox of peer evaluations is that if people can be dishonest in the efforts they expend, they also can be dishonest in their peer evaluations. Dishonesty in peer evaluations by a self-interested majority that free rides on the minority can be especially difficult to discern, especially vile, and not inconsistent with the history of minority discrimination in human society.

RATIONAL ANALYSIS

If free riding can neither be forestalled nor detected without sub-optimizing the group's outcome, then the best approach to the free-rider problem may be to accept free riding amorally, as a law of nature to which participants of the business game should attune themselves, in the same way that participants should attune themselves to the many other laws that govern business conduct, such as the accounting law that income is different from cash flow. Proceeding with this amoral free-rider-accepting approach, we consider the rational course for participant action when SP++ is the procedure used to organized them for play, and compare that course with the rational one when AI++ is used instead. Our analysis is focused on group size and based on two assumptions: observable conduct and incremental performance.

The observable-conduct assumption is that the conduct of each participant is observable to other participants, so that those participants who are motivated to perform well in the game are able to assess the attractiveness of other participants as members of their group. This assumption is satisfied in the traditional class setting, where students see each other frequently and can therefore know who attends classes, participates in class discussion, and behaves in other ways consistent with high performance in the game and contribution to their group. The observable-performance assumption may not be satisfied when classes are held online.

The incremental performance assumption is that the game is administered such that each participant's score in the game is the sum of the scores received in each decision period of the game, which in turn requires that the game involves more than a single decision period. To the extent that the game separates group performance from personal performance, our analysis does not require any particular relationship between the two, although we would expect the two to be interdependent. Moreover, our analysis does not require that credit for personal performance precisely reflects the value of the individual's contribution to the group, which may be impossible to ascertain in joint activity. Our analysis merely requires that the credit for a party's performance in each period, whether the party is an individual or a group, be reasonably based on the merits of that party's decisions in that period of the game.

Under SP++, the initial single-person-group assignment is not an equilibrium assignment if increasing group size substantially increases each member's absolute share of the group outcome. The group outcome may be in the form of risk reduction, synergistic profit from a joint activity, peer-to-peer learning, and other social rewards of collective effort. Accordingly, rational participants will exercise their freedom to switch from single-person groups to multi-person groups when they are either risk averse, or assess joint activity to be highly profitable, or place high value on peer-to-peer learning and other social rewards. Inasmuch as the outcome of group activity is necessarily dependent on the performance of its members, each member will prefer to join with those who are at least as high in performance as herself. Consequently, the highest and lowest performing participants will have the fewest choices of partners, because the highest performing participants will reject the many whose performances are substantially lower, and the lowest performing participant will be rejected by the many whose performances are substantially higher. As a result, participants who end the exercise as members of single-person groups will be composed predominately of the highest and lowest performers. This reasoning leads to our first testable hypothesis.

H1: *For the SP++ condition, participants who at the end of the exercise are members of single-person groups will have greater variance in their game scores than participants who are members of other groups.*

Continuing with our analysis of SP++, as the group increases in size from two to three or more, the increased size makes coordination of efforts increasingly more difficult and makes free riding increasingly more attractive to each of its members. We therefore expect high performers, who would be disadvantaged by free riders, to maneuver themselves into groups of a smaller size and expect low performers, who would be free riders, to maneuver themselves into groups of a larger size. This reasoning leads to our second testable hypothesis.

H2: *For the SP++ condition, participants' game scores will fall with increasing group sizes for group sizes greater than one.*

AI++ is the converse of SP++. Under AI++, the initial all-inclusive-group assignment is an equilibrium assignment if decreasing group size substantially reduces each member's absolute share of the group outcome. Otherwise and converse to the SP++ case, rational participants will exercise their freedom to switch from the all-inclusive group to a smaller group when they are not especially risk averse, or when they see the large size of the all-inclusive group as a hindrance to profitability, learning, and social rewards. Consequently, high performers will exit the all-inclusive group to form either smaller groups with other compatible members or single person groups, leaving the all-inclusive group to be composed of mediocre performers by the end of the exercise. This reasoning leads to our third testable hypothesis.

H3: *For the AI++ condition, participants who at the end of the exercise remain members of the initially all-inclusive group will have lower game scores than participants who are members of other groups.*

METHOD

We tested our analysis on a one-semester administration of GEO, the same game that Thavikulwat and Chang (2011) used in their investigation of PS+1. About 189 undergraduates from Hong Kong, Panama, and the United States took part in the exercise. To control for instructor, course, and setting across treatment conditions, only 60 U.S. undergraduates, who were enrolled in two sections of an international business course, were selected for this study. The SP++ condition was administered to one section; the AI++ condition was administered to the other section. Participants were not randomized across conditions, because the study is a design-science study aimed at establishing workability in a field environment rather than an analytical-science study aimed at proving theory (Klabbers, 2006).

SETTING

GEO is an international business game with an entrepreneurial focus (Thavikulwat, 2010). As such, the virtual companies of the game do not exist until participants found

Figure 1
Supply Chain of Products

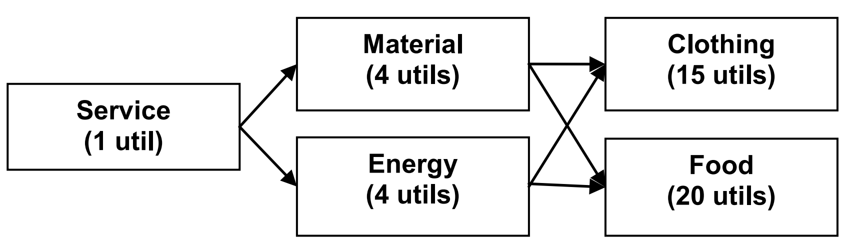
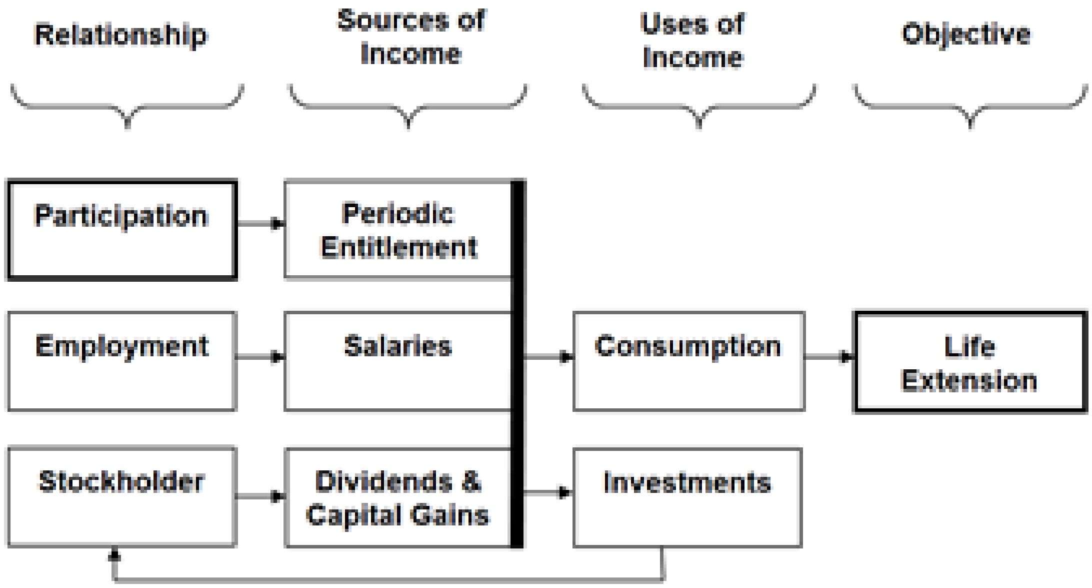


Figure 2
Performance Flow Diagram



them, which some participants choose to do sooner and others later or not at all, depending upon each participant's desire to be a leader or a follower, upon the financing available to each participant, upon the willingness of other participants to join in the entrepreneurial investment, and the like. Participants may found companies in any of five industries, the products of which form the supply chain illustrated in Figure 1. Thus, *services* must be purchased to produce *material* and *energy*, which in turn must be purchased to produce *clothing* and *food*. Companies specialize, so each company can produce only the products of its industry. The products are commodities with consumption utility values (utils) that depend only on their type, and not on the company that produces them.

Participants receive personal performance scores each period based on the accumulated utils of the products they purchase, hence virtually consume, within the period. The purchases require income, which comprises periodic entitlements from the government, salaries from employment as executives of companies, as well as dividends and capital gains, as illustrated in Figure 2. The personal performance scores are presented as periods added to lives (Thavikulwat, in press), with each participant living through several life cycles over the course of the exercise. The game is therefore a consumption-based, life-extension game, essentially a total-economy game at one level of comprehensiveness beyond the total-enterprise game as defined by Keys (1987).

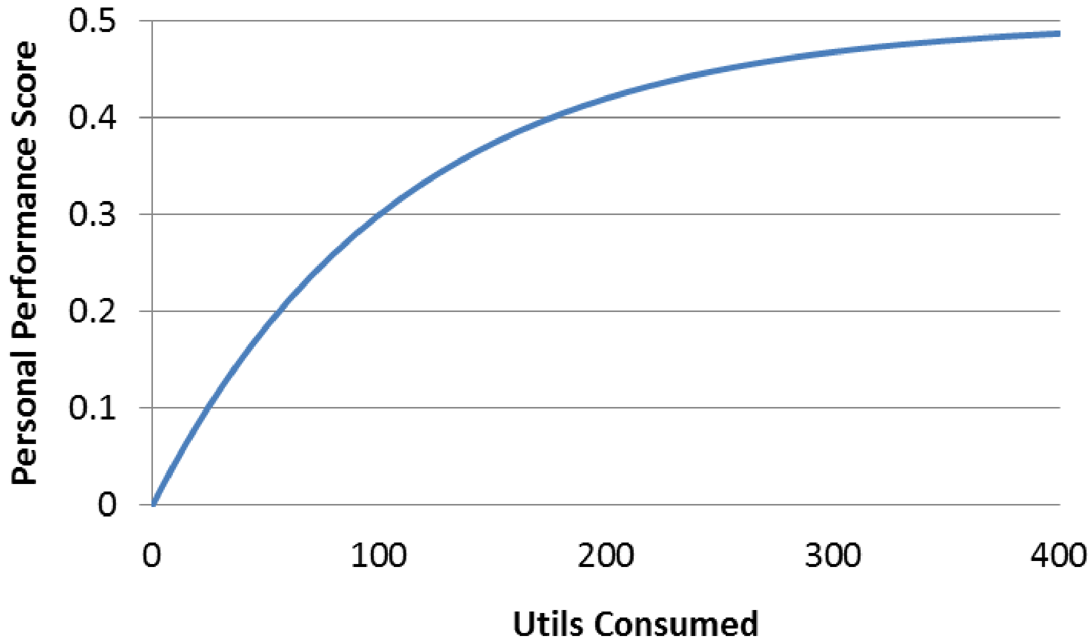
The game is computer-assisted (Crookall, Martin, Saunders, & Coote, 1986), inasmuch as interactions are predominately participant-to-participant rather than participant-to-computer and the consequences of decisions depend on the decisions of other participants playing complementing roles as customers and suppliers, rather than on models of how customers and suppliers should behave (Thavikulwat, 1997, 2003). The game registers participants individually, tracks the decisions each participant makes, and changes the decisions each participant is able to make based on the roles each participant acquires and relinquishes as the game proceeds.

The game is Internet-based (Pillutla, 2003) and clock-and-activity driven (Chiesl, 1990; Thavikulwat, 1996). Participants can access the game without a browser wherever a computer with an Internet connection is available. The periods of the game advance automatically, depending on the clock and the participants' collective level of activity. When a period advances, products are produced, interest is charged, income taxes are collected, entitlements are remitted, salaries are paid, and every participant is one period closer to the end of that participant's life cycle, which triggers a 100% tax on the participant's estate and transitions the participant to a new life, devoid of employment and assets that the participant had in the life just ended. Over the course of the semester, the game progressed through 200 periods, with the periods advancing at the starting pace of one period a week and accelerating gradually to the pace of one period every 5 hours by the last week of the semester.

MEASUREMENTS

Measurements for this study include the number of participants who at the end of the exercise were in a different group than the one to which they had been initially as-

Figure 3
Curve Relating Periodic Personal Performance Score to Utils Consumed Each Period



signed (group different), the number of times each participant changed groups (group changes), the number of life cycles each participant experienced (life cycles), the midterm exam score (midterm exam), the final exam score (final exam), the personal performance score (personal performance), and the group credit score (group credit). Of these measurements, group different, group changes, and life cycles are straightforward, so only the remaining measures will be explicated.

The midterm exam consisted of 40 multiple-choice questions on international-business topics covering course content preceding the midterm exam, and the final exam consisted of 50 similar questions covering course content after the midterm exam. As neither exam included any game-specific question, both serve as game-independent measures of the participants' propensity to learn from textbook and lectures.

Personal performance is the accumulated sum of the personal performance score each participant receives each period. This periodic score is an exponentially declining function of the participant's periodic consumption of utils, as illustrated by the curve of Figure 3. The function favors a participant who consumes more utils over one who consumes fewer utils, and favors the participant who consumes evenly across periods over one who consumes erratically.

Like personal performance, group credit is the accumulated sum of the periodic group credit score each participant receives in each period. In turn, the periodic group credit score is the mean periodic personal performance score of the group members for the period. Thus, if the members of a three-person group earn personal performance scores of .14, .30, and .40 in one period, each member will receive (.14 + .30 + .40) / 3 = .28 as that member's group credit score for the period.

GRADING

The grading formula for the course assures that participant grades, substantially based on exams, can be raised, but not lowered, by game scores, because exams earn required points whereas game scores earn elective points. Grades are based on the percentage of earned points to the sum of required points and earned elective points, which assures that the percentage basis for grades cannot exceed 100%. The midterm and final exams are allotted 80 and 100 required points, respectively. Quizzes and other assignments bring the total required points to 270. As for game scores, participants earn one elective point for the sum of their personal performance and group credit scores. So, if a participant earns a total of 300 points, 200 from the exams and other required activities and 100 from the game, the participant's percentage basis for grades will be 300 / 370 = 81.1%.

The formula gives rise to two notable effects on the motivation of participants. First, the formula assures that performance in the game can raise a participant's grade, but not lower it, which should reduce the risk of participants "choking under pressure" (Baumeister, 1984), because of the competitive nature of the game. Second, the formula is regressive in its treatment of game scores, because the participant who has earned fewer required points gains more in the percentage basis for grades from the same game scores than the participant who has earned more required points. The formula's regressive nature should therefore lower the correlation between game scores and exam scores that might be expected of business games that score individuals, because the abilities needed to perform well in exams and in games overlap (Anderson & Lawton, 1992, 1995; Thavikulwat & Pillutla, 2004).

ADVANTAGES TO MEMBERS OF LARGER GROUP

In our administration of the game, participants who are members of larger groups are advantaged over participants who are members of smaller groups, but the advantages are not overwhelming. First, larger groups convey a risk-reduction advantage, because the elective points that participants receive for their work in the game is computed by summing their personal performance and group credit scores, so group credit, computed by averaging the personal performance scores of its members, has as much weight on grades as personal performance. Second, larger groups convey a synergistic-profit advantage because the personal relationships accompanying group membership induce each participant to give first consideration to group members in employment, consolidation, and investment decisions. Employment decisions matter because GEO allows each company to employ one to three participants, and incentivizes the employment by raising the company's production ceiling as more participants are employed for longer durations. Consolidation decisions matter because GEO allows companies to acquire other companies, and incentivizes horizontal acquisitions by raising the production of horizontally integrated companies beyond the level of companies under separate ownership. Investment decisions matter because GEO requires all companies to meet a minimum investment requirement, which can only be met by sales of shares to members of the founder's group. Third, larger groups gives rise to more opportunities for peer-to-peer learning and other social rewards, because larger groups embody a larger body of knowledge and a greater likelihood that each member will meet at least one other with a compatible personality, ceteris paribus. These advantages are counterbalanced by coordination difficulties and the increased likelihood of deleterious conflicts and free-riding that rises with group size.

RESULTS

Descriptive statistics broken down by treatment conditions are presented in Tables 1 and 2, which shows no statistically significant difference in sex distribution between conditions (females, Table 1); in the number of participants who ended the exercise with a group different from the one to which they were assigned at the start (group different, Table 1); in the number of times participants changed groups (group changes, Table 2); in the number of life cycles participants experienced (life cycles, Table 2); in exam scores (midterm and final, Table 2); and in game scores (personal performance and group credit, Table 2). The absences of statistically significant differences between conditions suggest that participants of both conditions came indiscriminately from the same population. In both conditions, 40.0% of the participants ended the exercise with a group different from the one to which they were assigned at the start, a proportion significantly higher than the 6.6% under PS+1 as reported by Thavikulwat and Chang (2010), $\chi^2(1) = 31.09$, $p < .001$.

Table 1
Counts by Condition

	Condition		χ^2 (1)	*p*
	SP++	AI++		
n	30	30		
Females	20	13	2.43	.119
Group different	13	11	.069	.792

Note: Figures in parentheses are sample standard deviations.

Table 2
Mean Measurements by Condition

	Condition		*F* (1, 58)	*p*
	SP++	AI++		
Group changes	.53 (.730)	.50 (.777)	.029	.865
Life cycles	3.54	3.21	2.239	.140
Midterm exam	55.53 (11.41)	55.80 (9.22)	.010	.921
Final exam	56.77 (16.93)	55.73 (12.02)	.297	.588
Personal performance	41.43 (12.23)	38.26 (16.20)	.731	.396
Group credit	41.31 (11.61)	38.07 (12.20)	1.109	.297

Note: Figures in parentheses are sample standard deviations.

Correlations among exam and game scores, shown in Table 3, display an expected pattern. The moderately high correlation between the two exam scores is expected, because they are of the same kind while covering different content. The very high correlation between the two game scores also is expected, because group credit is based on the personal performance of group members. The absence of correlation between exam scores and game scores also is expected, considering the regressive treatment of game scores in the assignment of grades. Conformation of correlations to the expected pattern attests to the suitability of the measurements.

Mean exam and game scores under SP++ by ending group size are shown in Table 4. Overall, neither exam scores nor game scores are statistically different by ending

Table 3
Pearson Correlations of Scores

	Final	Personal performance	Group credit
Midterm	.540** (.002)	.012 (.951)	.115 (.546)
Final		-.004 (.981)	-.004 (.985)
Personal performance			.933** (.000)

**$p < .01$

Note: Figures in parentheses are 2-tailed levels of significance.

group size. Separating members of 1-person groups from members of other groups, however, the variance of personal performance is significantly higher among members of 1 -person groups than among members of larger-size groups, $F(8, 20) = 11.27$, $p < .001$, as is the variance of group credit, $F(8, 20) = 24.019$, $p <$ 001. Accordingly, **H1**, the hypothesis that under SP++ participants who at the end of the exercise are members of single-person groups will have greater variance in their game scores than participants who are members of larger-size groups, is supported.

Table 4
SP++ Mean Scores by Ending Group Size

	Ending group size				F (3, 26)	p
	1	2	3	4		
n	9	8	9	4		
Midterm exam	59.11 (9.28)	55.25 (15.78)	51.11 (9.33)	58.00 (10.46)	.793	.509
Final exam	55.78 (22.33)	63.25 (15.49)	54.00 (11.83)	60.00 (19.18)	.465	.709
Personal performance	40.60 (21.05)	43.91 (6.21)	42.88 (5.76)	35.08 (2.83)	.489	.687
Group credit	40.56 (21.01)	44.29 (1.15)	42.24 (3.60)	34.98 (2.48)	.577	.635

Note: Figures in parentheses are sample standard deviations.

Considering group sizes greater than one under SP++ (Table 4), the trend of decreasing personal performance with increasing group size is statistically significant, $F(2, 18) = 3.651$, $p = .047$, as well as the trend of decreasing group credit with increasing group size, $F(2, 18) = 16.245$, $p < .001$. Accordingly, **H2**, the hypothesis that under SP++ participants' game scores will fall with increasing group sizes for group sizes greater than one, is supported.

Mean exam and game scores under AI++ by ending group size are shown in Table 5. The trends of decreasing personal performance and group credit with increasing group size are both statistically significant. Dividing the participants into the 20 who remained members of the initially all-inclusive group and the 10 who exited the all-inclusive group, the difference in personal performance between the two categories is statistically significant, $F(1, 28) = 9.810$, $p = .004$, as is the difference in group credit between the two categories, $F(1, 28) = 12.000$, $p = .004$. Accordingly, **H3**, the hypothesis that under AI++ participants who at the end of the exercise remain members of the initially all-inclusive group will have lower game scores than participants who are members of other groups, is supported.

Table 5
AI++ Mean Scores by Ending Group Size

	Ending actual group size			F (2, 27)	p
	1	3	20		
n	7	3	20		
Midterm exam	56.86 (7.47)	48.67 (16.29)	56.50 (8.68)	1.001	.381
Final exam	55.43 (12.90)	60.67 (13.32)	55.10 (12.04)	.268	.381
Personal performance	53.54 (10.96)	40.86 (3.11)	32.52 (15.49)	5.891	.008
Group credit	48.27 (8.56)	45.26 (2.86)	33.43 (11.58)	5.908	.007

Note: Figures in parentheses are sample standard deviations.

CONCLUSION

In a game where the advantages of a larger-size group are counterbalanced by coordination difficulties and the possibilities of conflict and free riding, we find that participants behave rationally with respect to group size when they are initially assigned to single-person groups and also when they are initially assigned to one all-inclusive group. Evidently, group size matters to the participants. Our study is behavioral evidence that participants took group size into account in their group-membership decisions.

Both SP++ and AI++ overcome the limitations of PS+1, but we see no compelling reason to prefer either SP++ to AI++, or vice versa. In fact, the best procedure may be to assign participants randomly to SP++ and AI++, such that about half of the participants will be assigned to single-person groups and the other half, to an all-inclusive group composed only of that half. The result should be a higher proportion of participants changing groups, above the 40% level of this study, because the lowest performing participants of those assigned to the SP++ condition will be advantaged by switching to the all-inclusive group of the half assigned to the AI++ condition. The switch will further diminish the performance of the all-inclusive group, which should induce more of the higher performing members of the all-inclusive group to exit their assigned group. Random assignment to the SP++ and AI++ conditions therefore should raise the proportion of participants who will be presented with the free-rider issue and simultaneously empower them to resolve it, each in his or her own best interest—the shrewd free rider by joining the all-inclusive group, and the astute *hard charger*, to use Wolfe and McCoy's (2011) terminology for engaged participants, either by becoming single-person "groups" or by networking themselves into groups without free riders.

Our approach proceeds from the proposition that free-riding is a law of nature that should be dealt with amorally. This proposition is in contrast to the moral position underlying the use of peer evaluations, which presumes that free-riding is wrong, therefore something that should be administratively discouraged and punished. Our approach allows those who would be advantaged or disadvantaged by free-riding to network themselves into the group that is best for them. Further work in this direction may suggest networking principles that have application beyond business games.

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