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The effect of social motives, communication and group size on behaviour in an N-person multi-stage mixed-motive game*

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Abstract

Two experiments investigated the impact of social motives or individuals' preferences for specific self–other outcome distributions, on behaviour in an n-person game. Subjects' social motives (altruistic, cooperative, individualistic, competitive) were assessed prior to the decision-making in either 7-person games (Experiment 1) or 20-person games (Experiment 2). A modification of the n-person game format normally employed is introduced in this research to permit the choices made by players on a given trial to modify the payoff matrix available to self and others on subsequent trials. The game format, a simulated social dilemma, was presented in terms of a conservation of resources problem. In Experiment 1 communication opportunities were manipulated.

As predicted, there were consistent differences between the four classes of social motivation in the amount of the resources taken for self: competitive subjects took the most, individualistic subjects took less than the competitive ones but more than the average, while cooperative and altruistic subjects took the smallest amount of the resources for themselves. Moreover, competitive subjects expected the others to take fewer resources than they intended to themselves, and altruistic subjects expected the others to take more resources than they intended to themselves. These findings are only partly consistent with existing theories concerning the relationship between behaviour and expected behaviour of others.

In addition, when communication was allowed, significantly fewer resources were taken for self. Contrary to the predictions based on previous research findings, subjects in the 20-person groups did not take more resources for self than subjects in the 7-person groups.

INTRODUCTION

Human decision-making often occurs in settings where the choices of two or more interdependent actors have strong implications both for their own and other’s

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A formalization of the structural properties of one such type of interdependence can be found in prior conceptual and empirical studies of $n$-person games. Substantively, the conservation of resources or social dilemma paradigm defines an important class of settings which possess the structural properties of such decisional interdependence. This paradigm has been characterized by Hardin (1968), Messick and Brewer (1983), Olson (1965), Platt (1973) and others as one in which the immediate self-interest of decision makers is in conflict with their collective long-term interest.

The present research attempts in two ways to extend prior research which has employed $n$-person games to examine the resource conservation dilemma. First, it employs a decision task which is dynamic. Second, it assesses the effect of social motive in a dynamic decision task in which the structural factors communication and group size are manipulated.

**A DYNAMIC DECISION TASK**

A modification of the $n$-person game format normally employed is introduced in this research to permit the choices made by players on a given trial to modify the payoff matrix available to self and others on subsequent trials. Prior empirical research using traditional $n$-person games like the Prisoner’s Social Dilemma and the Chicken Social Dilemma (Caldwell, 1976; Dawes, McTavish and Shaklee, 1977; Kelley and Grzelak, 1972; Komorita, Sweeney and Kravitz, 1980; Meux, 1973) have presented subjects with binary choices between alternatives that afford either a moderate payoff that does not damage the collective interest, or a high payoff that entails some cost to all subjects. In these studies the numerical outcomes attached to each alternative are fixed over the trials of the game. Findings obtained in such studies are consistent with the hypothesis that, in small face to face groups (5 to 13 members) which make choices without communication with one another, the majority of members select the alternative that serves to maximize their own short-term interests at the expense of the long-term interest of the group of which they are a member.

Although there are strong similarities between the structural properties of the choice dilemma established in the preceding studies and those operating in actual conservation of resource situations, there is also an important dissimilarity. Namely, in the $n$-person games noted above, the decisions by actors on any given trial do not change the resources available on subsequent trials. In most real-life conservation of resource situations, of course, the situation is more dynamic. There, the outcomes produced by decisions at time $t$ influence the size of the pool of resources available at time $t + 1$.

There are several studies of conservation of resource dilemmas (Brechner, 1977; Messick et al., 1983; Stern, 1976) using simulated dilemma situations which are not formally conceptualized as $n$-person games, but which permit the total resources available on each trial to vary as a function of subjects’ prior choices and/or some form of experimenter intervention. That is, in a manner similar to many dilemmas in the ‘real world’, the interdependent decisions of actors not only influence the distribution of outcomes available at the time of choice, but also the outcomes available subsequently. In Dawes’ (1980) terminology these games are called
‘variable games’. These studies report that changes in the outcomes available through time can influence players’ decisional strategies. Hence, in the present study subjects are afforded the opportunity to make choices in a multi-stage n-person mixed-motive game, which we have called the Sequence Dilemma (Liebrand, 1982).

The Sequence Dilemma (SD) differs from the n-person games mentioned above in that there are more than two decisional alternatives at each stage and the decisions made at a particular stage influence the remaining resources, and hence the range of outcomes available on subsequent stages. The SD differs from the conservation of resource dilemmas in that subjects are provided information concerning the amount of resources left for the remaining stages. This property enables the subjects to derive an expected payoff at each decision point during the whole game. Although being in part a departure from the reality of many resource decisions, such feedback makes the present task analogous to prior n-person social dilemma games.

THE ASSESSMENT OF SOCIAL MOTIVATION

As second extension of prior resource conservation research, the present study considers the way in which the own-other outcome decision matrices presented by the experimenter are actually experienced by individual subjects. Kelley and Thibaut (1978) point out that the outcome matrix presented by an experimenter, which may be described as the given matrix, may not be the one on which the decisions of the actors are based. Rather one can expect actors to differentially transform the given matrix cell entries according to the personal values they place on the alternative own–other outcome distributions (cf. Kelley and Thibaut, 1978; McClintock, 1972, 1978). Kelley and Thibaut describe this process as one of moving from a given to an effective matrix. Kuhlman and Marshello (1975a, b) demonstrate that systematic differences in choices to a given matrix are made by subjects identified a priori as being cooperative, individualistic or competitive in social motivation. Hence, the second major extension of prior research involves a prior assessment of the preferences of actors for specific outcome distributions. That is, the specific social motivation of each subject is assessed prior to their participating in the Sequence Dilemma task, so as to provide a basis for examining the subsequent transformational process.

Structural mechanisms that affect decision-making

Among the structural mechanisms capable of affecting decision-making in dilemma situations, the effect of communication and group size has been well established (Dawes, 1980). In reviewing several studies, Dawes (1980) points out that the salutary effects of communication on group oriented decision-making are ubiquitous. When, subjects were allowed to discuss the dilemma problem (Bixenstine, Levitt and Wilson, 1966; Brechner, 1977) or when in addition to that type of discussion, they were allowed to elicit or extort commitments about each others’ behaviour, cooperation rates increased substantively (Caldwell, 1976; Dawes et al., 1977).
Prior research, however, has not been directed to a possible communication by social motivation interaction. For example, being confronted with an opinion from others may be more effective in promoting cooperative behaviour for subjects with a cooperative social motivation than for those more individualistically or competitively motivated, who might use the information in a self-interested or exploitative manner. In the first experiment reported here, communication opportunity is manipulated, since subjects in one condition are permitted to discuss the dilemma problem, and in another no communication is allowed.

Group size, the second structural mechanism, has also been found to be an important factor in determining the probable amount of cooperative behaviour in \( n \)-person dilemma tasks. With Olson (1965) and Messick (1973) one can assume that with increasing group size, both the individual’s share of responsibility for exhausting or conserving the resources decreases and the perception of relative anonymity increases. Hence, in larger groups persons should feel less constraint against behaving in a self-interested way for the short term. Prior studies assessing the effect of group size indeed do report somewhat less cooperation in larger groups (Bixenstine \textit{et al.}, 1966; Bonacich, Shure, Kahan and Meeker, 1976; Hamburger, Guyer and Fox, 1975; Komorita and Lapworth, 1982; Marwell and Schmidt, 1972). However, in these studies the range of group size is relatively small (up to nine persons). The present study attempts to more closely approximate and examine those processes which Olson and Messick describe as obtaining in resource dilemmas in larger groups. More specifically, the behaviour of seven person groups (Experiment 1) is compared with that of twenty person groups (Experiment 2).

**Dependent measures: own decisional behaviour; expectations about others**

Studies on game behaviour (Kelley and Stahelski, 1970; Kuhlman and Wimberley, 1976) have shown that in interdependent situations, own decisional behaviour covaries with the expectations about the decisional behaviour of others. In the present study the dependent variables consist of the strategy and choices actually made by subjects in the Sequence Dilemma, and their expectations concerning the decisional behaviour of others. The specific predictions made as regards how the dependent variables will vary as a function of the subject’s social motivation and the two manipulated structural variables, communication and group size, will be described at the beginning of each study. First, however, the following will be described: (a) the decision-making task, namely the Sequence Dilemma; and (b) the procedure for assessing individual differences in social motivation.

**The Sequence Dilemma**

In the experimental task, the Sequence Dilemma, there are five decision stages. At each stage, each subject can take between $1.50 and $9.00 from a common pool of resources. Further, subjects make their choices in private and are then informed about the total amount of resources consumed. Before making choices at any given stage, the experimenter announces the total amount of money chosen by subjects in the prior stages. In following these procedures, the resources consumed individually by subjects remain unknown to the other players. If the total amount requested by the players at the end of the five stages is greater than the initial pool size, each
subject receives nothing. If it is less, then each person gets the amount he or she requested.

The size of the total resource pool, or the total amount of money available is not fixed. Subjects are informed that there are five different pool sizes and that which one of these is their pool is randomly determined after choices have been made at all five stages. The sizes of the five total resource pools fall in between the extremes set by players choosing consistently the maximum amount of money for self at each stage, and their choosing consistently the minimal amount of money (see Figure 1). Since subjects are fully informed on all the constraints, they are confronted with the following dilemma. Choosing much money for self, which is the most-threatening strategy, can result in high earnings. However, if everybody does so, all five limits will be exceeded, and the earnings will equal zero. Hence, behaving in a self-interested way in the short term has a negative impact on both self and the common interest in the long run.

The Sequence Dilemma can be regarded as a multi-stage generalization of the Take Some Games discussed by Hamburger (1974, 1979) and Liebrand (1983). As Hamburger points out, the strategic properties of a Take Some Game can be derived by considering the probability distribution of the pool size at any given stage of decision-making. To illustrate this point, an analysis of the strategic properties of the procedures used in Experiment 1 is provided. In Experiment 1, each of 7 players could choose at each stage options worth either $1.50 or $9.00 or some amount in between. There were five stages and five equally spaced resource pool sizes, the lowest being $95, the highest $115. Each pool size had a probability of 0.2 of being drawn (see Figure 1). Consider any single player, say player A. Consider two strategies he or she might use. The first strategy might be to receive
the amount of money chosen with certainty, provided that on the average the other six persons would choose the same amount of money. Player A must then choose $13.50 across the 5 stages. Asking for $13.50 will result in a total that is below the lowest pool size and therefore, given that others have made similar choices, player A would always receive $13.50. A second strategy might be to achieve an equal share of the average pool size which is $105. This strategy therefore prescribes each player asking for $15.00 across stages. If this $15.00 strategy is used by all players there is a chance that the pool size to be drawn will be exceeded since the $95 and the $100 sizes are below the total amount chosen. The probability of getting a payoff with the $15.00 strategy is then 0.6, being the probability that the pool size will be $105, $110, or $115.

Thus far, the amount of money chosen by the others was considered identical to the amount for player A. Varying the amount of money chosen by the others yields an expected payoff function for each of the two above strategies (see Figure 2). It is apparent from Figure 2 that the more is chosen by the other players, the lower the expected payoff of player A will be. By assuming that others picking higher amounts is less preferred by player A, it is possible to describe preference orderings among expected payoffs. If, given player A’s $13.50 and $15.00 strategies, A believes that the average amount to be chosen by others is either $13.00 or $14.00, the preference ordering of expected payoffs for player A is identical to a Prisoner’s Dilemma preference ordering (Table 1). By varying player A’s strategies as well as the pair considered equally likely regarding the expected average choice of the
Table 1. Prisoner’s Dilemma preference ordering for player A (best possible outcome (1), worst possible outcome (4)), given two strategies by player A and by others

<table>
<thead>
<tr>
<th>Player A</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others</td>
<td>$13.00</td>
</tr>
<tr>
<td>’Ask for $13.50’</td>
<td>2</td>
</tr>
<tr>
<td>’Ask for $15.00’</td>
<td>1</td>
</tr>
</tbody>
</table>

other players, a different family of games (Hamburger et al., 1975) can be constructed.

It follows from the above analysis that the combination of own strategy and the expectations about the behaviour of the other players is important in determining the player’s perception of the structure of the game. It is also evident that the structure of a game depends on the specific stage of decision-making since with each successive stage more information is released to players. Therefore, the transformation process from the given matrix into the effective matrix is expected to depend on personal influences like own strategy and expectations concerning others’ strategies, as well as contextual influences like the increasing information on the amount of resources that have been expended.

**Individual differences in social motivation**

In the definition and measurement of social motivation, it is assumed that each motivation has its own utility function as determined by the linear combination of own and others’ outcomes (Wyer, 1969; Griesinger and Livingston, 1973). That is, differential weighting of the two components, own and others’ outcomes, yields various utility functions. Using this procedure, a geometric taxonomy defining various social motives was devised by Griesinger and Livingston (1973).

In this geometric model, the utility functions are represented as motivational vectors of infinite length extending from the origin of a two-dimensional space defined by the outcomes to self (horizontal axis) and the outcomes to the other (vertical axis). Given two self–other outcomes defined as points in this space, players are assumed to choose the outcome with the greatest projection on their preferred motivational vector. For example, as can be seen in Figure 3, a player with a motivational vector with slope −1 in quadrant 4, prefers the outcome 4 units to self and 2 units to the other (S) to the outcome which affords both players 4 units (R). Consistent with existing literature, four classes of social motivations are distinguished in the present study: **altruism**: the motivation to maximize other’s outcomes; **cooperation**: the motivation to maximize the sum of own and other’s outcomes; **individualism**: the motivation to maximize own outcomes; and **competition**: the motivation to maximize the difference between own and other’s outcomes (see Figure 3).

To assess which motivational vector is dominant for a particular individual, various measurement techniques using Decomposed Games (Messick and McClintock, 1968; Pruitt, 1967) have been proposed (Griesinger and Livingston,
1973; Kuhlman and Marshello, 1975b). The subjects’ task in a Decomposed Game is to select out of \( n \) own–other outcome distributions their most preferred one. Each distribution affords a certain payoff to the subject and to some other player. Generally, the other player remains unknown to the subject to avoid considerations of strategy. The payoffs for each distributional option can be represented as a point in the own–other outcome space, and subjects are expected to choose outcomes with the greatest projection on their preferred motivational vector. Confronting subjects with a series of Decomposed Games, using different combinations of outcomes, provides a measure to determine the direction of the subject’s preferred vector. The Decomposed Games procedure used to assess social motives in the present study is derived from the procedure originally proposed by Griesinger and Livingston (1973). However, in order to avoid the on-line computer connection required by their procedure, a straightforward paper and pencil version to be described in the Procedure section was developed.

**Behaviour in the Sequence Dilemma and social motivation**

Since the amount of money available in the Sequence Dilemma is restricted, there exists a strong interdependency between the outcomes of the persons involved. The outcome of the game depends on a combination of own strategy and the behaviour of the other players, and hence a chooser is likely to consider others’ probable
choices in making his or her own. Therefore, two dependent variables are added to
the main dependent variable, which is subject's resource choices. These two
variables provide an indication of a subject's relative position in his or her
decision-making group. The first variable, relative strategy, consists of the total
amount of resources, a subject is planning to choose across stages (i.e. subject's own
strategy), minus the average of his or her expectation of others' strategies. The
second variable, relative choice, consists of the choices actually made minus the
average of the choices actually made by the others in that decision-making group.

Starting with Kelley and Stahelski (1970), attention has been given to
interpersonal differences in the relationship between own game behaviour and the
perception of others. Specifically, Kelley and Stahelski have shown that there exist
differences between persons who describe their own intentions as cooperative and
persons who describe themselves as competitive. Their triangle hypothesis states
that competitive players, in general, expect others to be competitive as well, while
cooperative players expect others to be either cooperative or competitive. Miller
and Holmes (1975) and Kuhlman and Wimberley (1976) were successful in
replicating and extending the Kelley and Stahelski findings in the traditional
two-person, two-choice Prisoner's Dilemma Game. For other classes of game
settings however, it appears that interpersonal differences do exist but not in the
specific pattern hypothesized by Kelley and Stahelski. The data from Kuhlman and
Wimberley (1976) and Ross, Greene and House (1977) suggest that, in the
absence of any base rate, the expected dominant social motive is that one preferred
by the person himself. According to this egocentric attribution perspective, players
would expect others to choose similar amounts of money in the Sequence Dilemma
as they choose for themselves.

In the present study the above model of attribution is considered to be too
restrictive since nearly complete base rate information is available to the subjects at
the end of the game. Here it may be expected that during the game, when more and
more information on others' behaviour becomes available, the subject's prediction
of the amount of resources chosen by the average other across stages, becomes
better and better. In the present study, therefore, it is predicted that in the process
of receiving more information, a subject will behave in a way corresponding to his
or her preference for the distribution of outcomes for self and others. Specifically, it
is predicted that before the last stage of decision-making, the subjects' predictions
of their relative position in the group (relative strategy) and the actual relative
choices across stages correspond to the subject's motivational vector in the
own--other outcome space: altruistic subjects willingly choose less than the average
other; cooperative subjects willingly choose about the same as the average other;
individualistic and competitive subjects willingly choose more than the average
other, the difference for the competitive subjects will be the greatest.

The above set of predictions is conditional upon the base rate information given
to the subjects. In case base rate information is not available, the egocentric model
of attribution is considered the appropriate model to describe the perception of
others. In case base rate information is available, a subjective expected utility
maximization model based on the self--other outcome space is considered the
appropriate model. It is obvious that neither model accounts both for situations in
which base rate information is available and for situations in which such
information is not available. In the present study both models were combined.
EXPERIMENT 1

In this experiment the influence of the subject's social motivation on the dependent variables Own Resource Choices, Relative Strategy and Relative Choice, was investigated in two experimental conditions. In one of these conditions, subjects were permitted to discuss the dilemma problem. In the other no communication was allowed. It was predicted that the non-communicating groups would request more money than the communicating groups.

By means of the Decomposed Games technique subjects were classified \textit{a priori} as 'altruistic', 'cooperative', 'individualistic' or 'competitive'. It was predicted that subjects classified as having a cooperative social motivation would choose about the same amount of money for self that they expect others to choose; those classified as altruistic would choose less than the cooperative ones, and moreover, less than they expect others to do; those classified as individualistic or competitive both would choose more than the cooperative subjects. Specifically, it was predicted that scores on the variables, Own Resource Choice, Relative Choice, and Relative Strategy before the last stage of decision-making, would increase for the classes 'altruism', 'cooperation', 'individualism', and 'competition' respectively. Furthermore it was predicted that there would be no differences between the four classes of social motivation in their scores on the variable Relative Strategy before the first stage of decision-making in the Sequence Dilemma.

Finally, the social motivation-by-communication interaction was investigated. Subjects classified as 'cooperative' or 'altruistic' (group 1) were compared with those classified as 'individualistic' or 'competitive' (group 2). It was predicted that group 1 would be more compliant to the appeals made by others in the communication condition than group 2.

\textbf{Method}

\textit{Subjects}

Subjects, 132 volunteers (67 males, 65 females) responding to an advertisement in a local newspaper in Groningen, the Netherlands, were randomly assigned to one of 20 groups. Ten groups were in the communication condition; ten in the non-communication condition. Since eight of the 140 scheduled subjects did not show up, groups consisted of either six or seven persons. If the Sequence Dilemma requirements were met, subjects received the total sum they had chosen; otherwise they received a consolation payment of $1.50 per hour.

\textit{Procedure}

Subjects, who were seated in cubicles during the first part of the session, received instructions concerning the structure of the Decomposed Games, and then made 32 Decomposed Games choices. Thereafter, the instructions for the Sequence Dilemma were presented, and a quiz was administered to ensure complete understanding of this task. Once all the incorrect quiz-answers were explained, the subjects were brought to a large (9 \times 9 ft) table to participate in the second part of the session. Subjects were seated behind a small screen which prohibited them from
seeing each others' response sheets, while at the same time permitting them to see each other. Throughout the session, subjects were assigned and then addressed with a subject number ranging from 1 to 7.

Procedure for the Decomposed Games. The Decomposed Games technique employed consisted of making 32 choices between two own–other outcome combinations. The 32 pairs of outcomes lie either on a circle A or on a circle B in the own–other outcome space depicted in Figure 3. The centre of both the circles coincided with the origin of the outcome plane; the radius for circle A was $7.00 and $8.50 for circle B. There were 16 equally spaced pairs of outcomes on each of the circles while each pair consisted of two adjacent own–other outcome combinations. An example of such a pair is the choice between $3.30 for self and $7.90 for the other versus $6.00 for self and $6.00 for the other. This pair of outcome combinations is equivalent to the (A, c) versus (B, b) pair in Figure 4 when the radius of the circle is $8.50. Out of the 32 pairs of outcomes for the two circles, the subjects selected the pair of outcomes they preferred most.

Subjects were told that the other person in the Decomposed Games was another person whom they would never know. In the instructions the structure of the Decomposed Games format was thoroughly explained by means of two examples, but no advice was given on how to select the outcomes. Adding up the chosen amounts separately for self and for other yields an estimate of the subject's motivational vector. For example, suppose subject P's motivational vector is the one depicted in Figure 4. For P the most preferred outcome is (C, a) and the least

Figure 4. Distribution of self–other outcomes choices for Decomposed Games technique
preferred outcome is \((-C, -a)\). In selecting between \((C, a)\) and the two adjacent outcomes \((B, b)\) and \((D, o)\), the most preferred outcome will of course be \((C, a)\). For the remaining pairs of outcomes, the outcome with the shortest distance to \((C, a)\) will be chosen. Since any outcome has two adjacent outcomes, it is presented in two different pairings of outcomes to the subject. In one and only one of these two pairings this outcome has the shortest distance to the subject's preferred social motive \((C, a)\). Therefore, all the outcomes but \((C, a)\) and \((-C, -a)\) should be chosen just once, \((C, a)\) will be chosen twice and \((-C, -a)\) will never be chosen. As noted above, the projections of the selected outcomes on the own- and on the other-outcome axis are added up. If the subject is choosing consistently with a given social motive all the selected outcomes, except \((C, a)\) are cancelled by the one on the opposite side on the circle. For example, \((B, b)\) is cancelled by \((-B, -b)\) and \((D, o)\) by \((-D, o)\). Since \((C, a)\) was chosen twice, the resultant of the adding procedure has twice the projection of \((C, a)\) on the two axes, indicating the direction of subject P's motivational vector.

Next, subjects were classified into one of four classes of social motivation, if the percentage of choices identical with a consistent choice pattern according to one of the four social motives exceeded 60 per cent. In that case all observed motivational vectors in between degree 112.5 and 67.5 (Figure 3) were labelled altruistic, all vectors in between degree 67.5 and 22.5 were labelled cooperative, all vectors in between 22.5 and 337.5 were labelled individualistic, and all vectors in between degree 337.5 and 292.5 were labelled competitive. In Experiment 1, 105 of the 132 subjects, and in Experiment 2, 94 of the 101 subjects (across experiments 85 per cent) could thus be classified. The 60 per cent consistency level was used to eliminate subjects who made their choices nearly randomly. Such a choice pattern would have had a consistency level of about 50 per cent. The overall level of consistency for Experiment 1 is 76 per cent for Experiment 2, 80 per cent.

**Procedure for the Sequence Dilemma.** The structure of the Sequence Dilemma was explained in terms of a conservation of energy paradigm, in order to make the abstract characteristics of the task both more concrete and more realistic. A conservation of energy paradigm has the advantage that on the one hand there exists uncertainty about the total amount of resources available, while on the other hand, conservation of this resource is in general seen as desirable.

Each of the persons made four anonymous pair-wise selections at each of five stages. The options to be selected involved a certain consumption of energy which was expressed in monetary units available to the subject: selection 1: using a private car (yielding $3.00) versus public transport (yielding $.50); selection 2: dishwasher ($3.00) versus no dishwasher ($.50); selection 3: colour TV set ($1.00) versus black and white TV set ($.25); selection 4: laundry dryer ($2.00) versus no laundry dryer ($.25). The minimum amount of energy used or alternatively the minimum amount of money that each person could choose for self at each stage is $1.50, the maximum amount is $9.00.

Subjects were told that the stages corresponded to a certain amount of time (period) and that the total amount of energy resource (money) available across the five periods would be $95, $100, $105, $110, or $115. For the six person groups these pool sizes were adjusted to fall between $80 to $100, and subjects were informed that each pool size had a probability of 0.2 to be drawn after all the decisions had been made.
Actually, the monetary units presented to the subjects were Dutch guilders. These guilders are translated here into dollars (1 dollar = 2 guilders). Subjects were told that they were making real money decisions and that they would be paid the amount of money they had chosen for self, if the total amount chosen in their group across stages had not exceeded the pool size drawn. After each stage of decision-making, subjects were informed concerning the total cumulative amount of money chosen. No information was given concerning the cumulation of money by individual subjects. Prior to each stage, subjects had to report in writing their own intended strategy: At this moment I expect to choose across the stages $\ldots$, and their expectations about the intended strategy of each of the other group members. Subsequently, they made their choice for that particular stage.

Throughout the instructions, no reference was given to the desirability of selecting particular options. In the non-communication condition subjects were not allowed to communicate. Subjects in the communication condition could discuss the dilemma for 10 min before stage one, and for 5 min before each of the remaining stages. There were no restrictions on the topics to be discussed, as long as the choices remained secret. Following the discussion, subjects privately filled out a sheet containing questions on the strategy of each of the players and made their choices for that particular stage of decision-making.

Results

Effects of communication and social motivation across stages

In 7 of the 10 decision-making groups within the communication condition, the total amount of money chosen across stages was lower than the lowest possible pool size; the probability of getting the amount of money chosen in each of the remaining groups was 0.8. In contrast, within the non-communication condition, the lowest possible pool size was exceeded by all the groups. In addition, the amount of money chosen in one of these groups exceeded the highest possible pool size; the remaining 9 groups in the non-communication condition had an average probability of 0.54 to receive the amount of money chosen.

In the analysis of the effect of communication and social motivation on subject’s own resource choices, the differences between the 20 decision-making groups (MS-A) and the groups by social motivation interaction (MS-AB), were considered to be estimates of the experimental error in a partially hierarchical design (Winer, 1962, p. 184). Preliminary tests of the effect of MS-A and MS-AB yielded insignificant F-ratios at the 0.10 level of significance. Consequently, MS-A and MS-AB were combined with the within-cells estimate of experimental error to a pooled error term. The final test yielded significant effects for communication ($F(3, 97) = 4.61, p < 0.05$), and for social motivation ($F(3, 97) = 3.70, p < 0.05$). The social motivation by communication interaction effect accounted for virtually no variance.

As appears from Table 2, subjects in the non-communicating groups requested on the average $1.48 more across stages than the subjects in the communicating groups. Though the overall effect of communication was huge, it appeared that communication had about the same effect on each of the four classes of social
motivation (see Table 2). Hence, the hypothesis concerning the social motivation by communication interaction was not supported.

As can be seen from Table 2, social motivation affects the resource choices made in the Sequence Dilemma in the predicted way. The resource choices made across conditions increase from $11.50 for altruistic subjects, to $13.48 for cooperative subjects, to $15.08 for individualistic subjects, and finally to $17.04 for competitive subjects.

### Social motivation; relative choice

In addition, the five relative choices made by each subject (see Figure 5) were analysed in a repeated measures model with social motivation as the between subjects factor. Using the sum of subject's relative choices as dependent variable, a significant effect for social motivation was obtained ($F(4, 101) = 3.98, p < 0.05$).
Across stages, competitive and to a lesser degree individualistic subjects chose more than the average other in their groups; altruistic and to a lesser degree cooperative subjects chose less than the average other. An additional analysis, in which the subject’s five relative choices were used as dependent variables, yielded no significant univariate or multivariate effects for the linear, quadratic, cubic and quartic trends. As can be seen from Figure 5, there is no indication that individualistic and to a greater extent competitive subjects tended to adapt to the realities of running out towards the end of the game. On the contrary, throughout the game they chose more than the average other in their group.

Social motivation; relative strategy

Next, the hypotheses concerning the relation between own behaviour and expected behaviour from others were analysed. Prior to each stage of decision-making, subjects made predictions concerning the cumulative amount of resources chosen by self (own strategy) and by each of the other players (other’s strategies). Both variables are depicted in Figure 6. Using as dependent variable the difference between both variables at stage 5, i.e. stage 5 relative strategy, a one-way analysis of variance yielded a significant effect for the linear polynomial contrast among the means of the four classes of social motivation ($F(1, 78) = 4.99$, $p < 0.05$). The quadratic and cubic polynomial contrasts yielded insignificant effects. In the analysis in which stage 1 relative strategy served as dependent variable, none...

![Figure 6. Own strategy and expected strategy of others, by stage in 7-person Sequence Dilemma; broken down for social motive](image-url)
of the polynomial contrasts yielded significant effects. It was concluded that the pattern of relative strategies fits the predicted one.

Next, the accuracy of subject's predictions concerning own and other's resource choices was analysed. Because group specific constants, such as a high or low resource depletion, do not have any effect on the variables relative strategy and relative choice across stages, the correlation between both variables was considered to be an indication of subject's accuracy. The Pearson correlation coefficients between relative strategy and relative choice across stages, gradually increased from 0.21 (stage 1) to 0.55 (stage 5). The results support the conclusion that the feedback given during the game, was effective in increasing the accuracy of subject's perception of other's choice behaviour. Hence, it was concluded that subjects very likely were aware of the differences between their own resource choices and those of others in their group.

Effect of feedback

The overall effect of feedback about others' choice behaviour on subject's subsequent choice appeared to be negligible. For the communication condition the Pearson correlations were, stage 2: –0.05; stage 3: 0.05; stage 4: –0.22; stage 5: –0.25 (p < 0.05). For the non-communication condition, stage 2: 0.16; stage 3: –0.04; stage 4: –0.13; stage 5: 0.08. It is concluded that feedback about others' choice behaviour apparently creates a conflict between tendencies to cooperate and tendencies to defect (cf. Messick and Brewer, 1983).

Effects of communication and sex per stage

The amount of money chosen as a function of communication, sex and stage of decision-making is shown in Figure 7. The five resource choices made by each subject were analysed as repeated measures (Finn and Mattson, 1978), with communication and sex as the two between subjects factors and stages as the within subjects factor. In this analysis the data of the subjects which could not be classified into one of the classes of social motivation (n = 27; see procedure section) were included. The analysis yielded significant univariate effects for the linear, quadratic and cubic trends; the quartic trend was not significant. In addition significant multivariate effects were obtained for the first three polynomials taken together \(F(3, 126) = 33.73, p < 0.05\), and for the polynomials by communication interaction \(F(3, 126) = 15.73, p < 0.05\).

The polynomials by communication interaction was analysed by comparing the proportion of the total effect variance (i.e. the variance of the average choice for each stage) accounted for by the linear, the quadratic and the cubic polynomial, separately for each condition (Keppel 1973). In the non-communication condition the linear polynomial accounted for 96 per cent, the quadratic polynomial for 3 per cent, and the cubic polynomial for 0.7 per cent of the total 'average choice per stage' variance. In the communication condition, these proportions were 28, 24 and 47 per cent respectively. It was concluded that communication had a levelling effect on the exploitation of resources during the first stages of decision-making.

In addition to the above analysis of resource choices per stage, the overall effect of communication and sex was tested by creating as dependent variable the sum of the five resource choices. The analysis, in which all subjects were included, again
yielded a significant effect for communication ($F(1, 128) = 5.41, p < 0.05$), and for sex ($F(1, 128) = 4.22, p < 0.05$). On the average males chose $1.36$ more than the females did. There was no significant communication by sex interaction effect. Finally, by means of a Chi-Square test it appeared that there were no distributional differences in social motives between males and females ($\chi^2(3) = 1.18$, n.s.).

**Discussion of Experiment 1**

The hypothesis that actors with different social motives would make different resource choices is strongly supported in this experiment. As was predicted, subjects classified as having a competitive social motivation willingly chose more for self than the other subjects, and conversely, subjects with an altruistic social motivation willingly chose less than the average other. The choice behaviour of individualistic and cooperative subjects also fits the predicted pattern.

Finally, no evidence was found indicating that communication had a differential effect on subjects having different social motives. The present findings concerning the effect of communication, seem to support also Festinger’s (1953) hypothesis that pressures toward uniformity among members of a group may occur, because uniformity is considered desirable, or necessary, in order for the group to achieve its goal. Further implications of the findings reported above will be discussed in the General Discussion.
The existence of sex differences in n-person mixed-motive games has not been found to be a consistent phenomenon. Caldwell (1976) reported no sex differences in a five-person Prisoner’s Dilemma Game, and Dawes et al. (1977) found that females were more likely to cooperate in only one of the two Prisoner’s Dilemma experiments conducted. In this experiment, females chose less for self than males. A tentative conclusion might be that in n-person mixed-motive games, females are less self interested than males.

EXPERIMENT 2

In Experiment 2, resource choices in the Sequence Dilemma were made in twenty-person groups. No communication was allowed. Because of the large group size, some minor changes were introduced in the design of the Sequence Dilemma. These will be noted in the Procedure section. All the other important parameters, the number of stages, the range of resource choices on each decision-making stage, and the average amount of resources expected to be available for each subject, were identical with those employed in the first experiment.

As noted previously, one can assume that in larger groups persons should feel less constraint against behaving in a short-term self-interested way. Therefore, it was predicted that in general subjects in 20-person groups would choose more money for self than the subjects in the non-communicating 7-person groups. The hypotheses regarding the relationship between the social motivation of actors and their choice behaviour in the Sequence Dilemma remain the same.

Method

Subjects

Participants in this experiment were 101 volunteers (58 males; 43 females) responding to an advertisement in a local newspaper in Groningen, the Netherlands. Subjects were randomly assigned to one of five groups, each group consisting of either 19, 20 or 21 persons. If the Sequence Dilemma requirements were met, subjects received the total amount of money they had chosen for self, otherwise as in Experiment 1, they received $1.50 per hour.

Procedure for the Sequence Dilemma

Subjects were seated in a 3 x 7 pattern in a large room at a minimal distance of 6 ft from each other. In order to reduce the amount of calculations during the experimental task, it was decided to let the subjects select only one out of five options at each stage of decision-making. All the options involved a certain consumption of fossil fuels for the heating of water. The five options used in Experiment 2 were created in such a way that the minimum and the maximum amount of money the options afford were identical to those employed in Experiment 1.

There were five fossil fuel pool sizes, each with a probability of 0.2 of being drawn after all the decisions were made For the earlier 7-person group condition
Multi-stage mixed-motive game

(Experiment 1), the middle pool size was $105, which is $15 per subject. In order to make the pool sizes comparable between the two experiments, pool sizes were adjusted in such a way that the middle pool size always equalled 15 times the number of subjects.

Results

Effects of group size and social motivation

In one of the five decision-making groups the total amount of money chosen across stages exceeded the highest possible pool size; in the remaining four groups the average probability of receiving the amount of money chosen was 0.4.

As in Experiment 1 the effect of social motivation on subject's own resource choices was analysed in a partially hierarchical design. Again, in the final test MS-A and MS-AB (see Experiment 1) could be pooled with the within-cells estimate of experimental error. The analysis yielded a significant effect for social motivation ($F(3, 90) = 3.68, p < 0.05$). As appears from Table 3, the findings of Experiment 1 concerning the effect of social motivation on decision-making in the Sequence Dilemma were replicated.

The average amount of money chosen for self across subjects and stages is $16.03 (sd = 7.06), which is higher than the average amount chosen in the 7-person non-communicating groups ($M = 14.99, sd = 4.61$). Though it was predicted that subjects in the 20-person groups would choose more money, the difference is not significant ($t(142) = 1.08$, separate variance estimates). However, the variability between the amounts taken for self is significantly higher in the 20-person condition than in the 7-person non-communicating groups ($F(93, 52) = 2.35, p < 0.05$).

Social motivation; relative choice

Using the sum of subject's relative choices as dependent variable, a significant effect for social motivation was obtained ($F(3, 90) = 3.8, p < 0.05$). Across stages competitive subjects chose $5.47$ more and individualistic subjects chose $1.48$ more than the average other subject in their group (see Figure 8). On the other hand, cooperative and altruistic subjects chose considerably less than the average other subject, that is $1.79$ and $3.07$ respectively. As in Experiment 1, there is no indication that competitive and to a lesser degree individualistic subjects, were choosing less than the average other in order to compensate for their excessive choice behaviour in the beginning of the game.

Table 3. Own resource choices broken down for four classes of social motivation; number of subjects within parentheses, 20-person groups Experiment 2

<table>
<thead>
<tr>
<th></th>
<th>Altruistic</th>
<th>Cooperative</th>
<th>Individualistic</th>
<th>Competitive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average resource choice</td>
<td>(3)</td>
<td>(53)</td>
<td>(28)</td>
<td>(10)</td>
<td>(94)</td>
</tr>
<tr>
<td>13.50</td>
<td>14.35</td>
<td>17.73</td>
<td>21.00</td>
<td>16.03</td>
<td></td>
</tr>
</tbody>
</table>
Figure 8. Relative choices for four classes of social motivation by stage in 20-person Sequence Dilemma; comp = competitive, indi = individualistic, coop = cooperative; alt = altruistic

Figure 9. Own strategy and expected strategy of others, by stage in 20-person Sequence Dilemma; broken down for social motive
Social motivation; relative strategy

Figure 9 shows both subject's own strategy at each stage and subject's expectations concerning the strategy of others at each stage.

As was expected, at the end of the game, relative strategy data increased for the classes 'altruism', 'cooperation', 'individualism' and 'competition' respectively. A one-way analysis of variance on stage 5—relative strategy yielded a significant effect only for the linear polynomial contrast among the means of the four classes of social motivation ($F(1, 90) = 5.65, p < 0.05$). However, contrary to the expectations and contrary to the results of Experiment 1, the effect of the linear polynomial contrast among the average stage 1—relative strategies of the four classes of social motivation was significant ($F(1, 90) = 10.67, p < 0.05$). A possible explanation of this finding is discussed in the General Discussion section.

The accuracy of subject's predictions concerning own and other's resource choices was analysed by means of the Pearson correlation coefficients between relative choice and relative strategy. The correlation coefficients increased gradually from 0.36 (stage 1) to 0.68 (stage 5). As in Experiment 1 it was concluded that subjects very likely were aware of the differences between their own resource choices and those of others in their group.

Effects of sex

In order to analyse possible sex effects a $2 \times 4$ (sex x social motivation) analysis of variance was carried out on subject's relative choices summed across the five stages. The analysis yielded a significant effect for sex ($F(1, 87) = 9.64, p < 0.05$) and for social motivation ($F(3, 87) = 2.81, p < 0.05$). There was no significant sex by social motivation interaction. As in Experiment 1, males chose more for self than females. It appeared that males chose $2.10$ more than the average other group member while females chose $3.03$ less than the average other group member.

Effects per stage

Subject's five resource choices were analysed using a multivariate analysis of repeated measures with sex as between subjects factor. Besides the multivariate effect for the linear and quadratic trends ($F(2, 91) = 38.7, p < 0.05$), only the first two polynomials had a significant univariate effect. No sex by polynomial interaction was found. As in Experiment 1 the effect of feedback on subject's subsequent choice was not significant. The Pearson correlation coefficients were, stage 2: 0.09; stage 3: 0.03; stage 4: −0.03; stage 5: 0.08.

GENERAL DISCUSSION

One major finding in this study is that, as expected, there is a covariation between interpersonal differences in social motivation and game behaviour. The game format used in the present study allows subjects to compare their own behaviour with that of others, while more information concerning the behaviour of others is gradually released. It appears that competitively motivated subjects, while becoming more and more aware of the fact that they take more out of the common
pool than the others in their group, persist in this behaviour. This obtains both in
the seven and in the twenty-person groups. Likewise, in both experiments,
individualistic subjects also take more out of the resource pool than the average
other in their group, although not to the degree as competitive ones. Cooperative
and altruistic motivated subjects on the other hand take about the same or less
resources than the average other. Some interesting research questions concerning
the effect of social motive arise. What will be the difference between
decision-making groups consisting of either cooperators or competitors? To which
degree is it possible to influence the subject's motive, and which mechanisms are
capable of accomplishing that? Answers to these questions will hopefully be
provided by future research.

A second finding concerns the relationship between group size and the amount of
resources chosen for self. It appears that, on the one hand, the average amount
taken for self is not significantly greater in the 20-person groups than in the
7-person non-communicating groups. However, on the other hand, the variability
between the amounts taken in the 20-person condition is greater than in the
7-person non-communicating groups. This finding indicates that the exploitative
behaviour of some subjects in the 20-person groups is compensated by the
behaviour of subjects taking only a modest share of the common resources. These
differences between subjects are shown in Table 3 and in Figure 8. Those subjects
taking more than the average other, mainly can be found among the competitively
and individualistic motivated subjects. These data do suggest that, among subjects
with cooperative or altruistic social motives, promoting of the group's welfare at the
cost of one own's economic gain can be found. As Messick (1974) pointed out, in
large group mixed-motive situations, given some concern for the group, the
ultimate deficient outcome for all members can be postponed a long time.

Recently Stroebe and Frey (1982) pointed out that, except in the case of
experimental games, researchers appeared to have had problems in demonstrating
sizeable effects of an increased group size on the willingness to contribute to a
public good. The findings of the present study indicate that their conclusion may
apply to some experimental games as well. Because the present experimental game
differs from the n-person Prisoner's Dilemmas Stroebe and Frey are referring to, it
seems worthwhile to investigate possible differences between different classes of
experimental games, in their capability to elicit the free-rider effect. In other words,
research on the ecological validity of the different classes of experimental n-person
games is warranted.

A third finding concerns the relative strategies of subjects classified as
competitive or cooperative. The pattern of data is not consistent with Kelley and
Stahelski's (1970) triangle hypothesis. Namely, in both experiments, after
information on the behaviour of other's becomes available, competitive subjects do
not assume that others have strategies similar to their own. Rather they continue to
expect differences between their own and others' strategies. Furthermore, there is
no behavioural assimilation of the cooperative subjects to the competitive subjects'
strategy of taking more resources for self than is requested by the average other. It
appears that the specific pattern of expectancies hypothesized by Kelley and
Stahelski to obtain for actors with particular social motives, is not valid for the
game format used in this study.

Part of the present relative strategy findings are more consistent with the
hypothesis proposed by Kuhlman and Wimberley (1976). They state that subjects expect most others to hold social motives similar to themselves. According to this hypothesis and according to egocentric attribution theory (Ross et al., 1977), when no information on others' behaviour is available, persons with differing social motivation assume that the others will be similar to self. Relative strategy data prior to the first stage decision-making in the Sequence Dilemma, before any feedback, are relevant to this hypothesis. It appears that in the 7-person groups (Figure 6), the data are consistent with Kuhlman and Wimberley's hypothesis: between the four distinguished classes of social motivation there were no significant differences in first-stage relative strategies. However, the data for the 20-person groups do not support Kuhlman and Wimberley's hypothesis.

There are two mechanisms that may account for the different first-stage relative strategy patterns between the 7-person and the 20-person groups. First, in 20-person groups the influence of one person on the group's resources is much smaller than the corresponding influence in the 7-person groups. Feelings of responsibility for the common resources, therefore, are expected to be relatively low in the 20-person groups. Second, though all resource choices remain secret, feelings of social pressure in 7-person face to face groups are presumably greater than those feelings in 20-person groups. The joint effect of relatively low responsibility and low social pressure makes it more likely that, prior to the decisions for the first stage, a person's intended strategy is considered easier to accomplish in the 20-person groups than in the 7-person groups. Consequently, differences in first-stage relative strategies between classes of social motivation, should appear first in the 20-person groups.

The results of the present study have confirmed that both the triangle hypothesis and Kuhlman and Wimberley's hypothesis are too restrictive to explain the pattern of relative strategies and relative choices throughout the decision-making process. In the present study, it was found that subject's expectations concerning their relative position in the group, were described more accurately by using a subjective expected utility maximization model, based on the self–other outcome space. This result is seen as a conceptual and empirical extension of research concerning the relationship between own behaviour and expected behaviour of others.

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**Résumé**

Deux expériences ont examiné l’impact de motifs sociaux et de préférences individuelles pour des distributions spécifiques de gain (pour soi et autrui) sur le comportement dans des jeux à n-personnes. Les motifs sociaux des sujets (altruistes, coopératifs, individualistes, compétitifs) furent évalués avant la prise de décision dans des jeux à 7 personnes (recherche 1) ou à 20 (recherche 2). Une modification par rapport à la procédure normalement employée dans les jeux à n-personnes a été introduite; elle permettait que les choix effectués par les joueurs lors d’un essai donné modifient la matrice des gains pour soi et autrui lors des essais suivants. Le jeu, une simulation de dilemme social, était présenté comme un problème de conservation de ressources. Dans la première recherche, les possibilités de communiquer furent manipulées.

Conformément aux prédictions, il y eut des différences consistantes entre les 4 classes de motivation sociale en ce qui concerne la quantité de ressources prises pour soi: les sujets compétitifs prirent le plus, les individualistes prirent moins que les compétitifs mais davantage que la moyenne, tandis que les sujets altruistes et coopératifs prirent le moins. En outre, les sujets compétitifs s’attendaient à ce que les autres prennent moins de ressources pour eux qu’ils ne l’ont fait alors que les sujets altruistes s’attendaient à ce qu’ils en prennent plus. Ces résultats ne sont que partiellement consistants avec les théories actuelles concernant le rapport entre comportement et comportement attendu de la part d’autrui.

De plus, lorsqu’il était permis de communiquer, les sujets prenaient significativement moins de ressources pour eux-mêmes. Contrairement aux prédictions basées sur les recherches antérieures, les sujets dans les groupes de 20 personnes ne prenaient pas plus de ressources pour eux-mêmes que les sujets dans les groupes de 7 personnes.

**Zusammenfassung**

Zwei *n*-Personen-Spielexperimente erlaubten, den Einfluss der sozialen Motivation oder der individuellen Bevorzugung von spezifischen Selbst/Andere-Verteilungsergebnisse zu untersuchen. Die soziale Motivationslage der Vpn (altruistisch, kooperativ, individualistisch, konkurrierend) wurde vor dem 7-Personenspiel (Experiment 1) und vor dem 20-Personenspiel (Experiment 2) getestet. Der übliche Ablauf der *n*-Personenspiele wurde dahingehend verändert dass die Entscheidung der Spieler bei einem gegebenen Versuch die Gewinn/Verlust matrize für die folgenden Versuch beeinflusste.

Das Spiel, ein simuliiertes Sozialdilemma, wurde als ein Problem der Reservenverwaltung dargelegt. Im Experiment 1 waren die Kommunikationsmöglichkeiten der Vpn manipuliert.

Wie vorausgesagt, konnten bei der persönlichen Reservenbeanspruchung der vier sozialen
Motivationsklassen Unterschiede festgestellt werden: konkurrierende Vpn beanspruchten am meisten, individualistische Vpn beanspruchten weniger als erstere aber mehr als der Durchschnitt, während kooperative und altruistische Vpn am wenigsten beanspruchten. Dazu kommt, das konkurrierende Vpn erwarteten, das die übrigen Vpn die Reserven weniger beanspruchten und altruistische Vpn nahmen an, dass die übrigen Vpn die Reserven mehr beanspruchten als dies tatsächlich der Fall war. Diese Resultate sind nur zum Teil im Einklang mit den gängigen Theorien zur Beziehung von persönlichem Verhalten und dem erwarteten Verhalten der andern.

Überdies wurde festgestellt, dass die persönliche Reservenbeanspruchung bei offener Kommunikationsmöglichkeit signifikant kleiner war. Im Gegensatz zu Voraussagen, die auf früheren Forschungsergebnissen beruhen, beanspruchten die Vpn im 20-Personenexperiment nicht mehr von den Reserven als die Vpn in der 7-Personengruppe.