THE DICTATOR: A FOUR-PERSON GAME

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Zusammenfassung

DIKTATOR ist ein Vier-Personen-Spiel (in Form einer charakteristischen Funktion), bei dem einer der Spieler (der "Diktator") dadurch ausgezeichnet ist, daß er nach jeder Verhandlungsrunde den zu verteilenden Betrag nach eigenem Gutdünken und ohne Berücksichtigung des vorher erzielten Verhandlungsergebnisses austeilen kann.Er muß allerdings damit rechnen, in nachfolgenden Runden aus der großen Koalition ausgeschlossen zu werden.

Das Spiel wurde im Rahmen eines Experiments mit 120 Studenten unterschiedlicher Fachrichtungen durchgespielt, die Ergebnisse wurden mit spieltheoretischen Lösungen verglichen. Darüber hinaus wurden der Erfolg und das Verhalten der Spieler im Zusammenhang mit Persönlichkeitsmerkmalen (z.B. Leistungsmotivation, Geselligkeitsbedürfnis; erhoben durch einen Fragebogen) untersucht.

Abstract

DICTATOR is a four-person game in characteristic function form, where one of the players (the "Dictator") is distinguished in so far as after each round he can allot the amount to be distributed irrespective of the agreement reached in preceding negotiations. Of course, he must rely upon being excluded from the grand coalition in subsequent rounds.

The game was played during an experiment with 120 universtity students participating. A comparison of the results with game-theoretic solution concepts was made. Moreover, success and behaviour of the players was studied in connection with personality characteristics, e.g. need for accievement or need for affiliation, which was measured by means of a questionnaire.

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Introduction

Experimental games provide a link between normative and descriptive theories of collective decision, especially in the context of n-person cooperative games. The normative theory provides a plethora of "solutions" of such games in the sense of prescribing payoff configurations that satisfy particular conceptions of individual and collective reationality or, perhaps of equity. Results of experiments produce observed payoff configurations, which can be compared with the several prescribed ones. Relative goodness of fits to the several proposed solutions suggests hypotheses about the relative "attractiveness" of the solutions based on conjectures about their socio-psychological relevance.

For example, the core of an n-person cooperative game in characteristic function form (if it exists) can be said to confer stability on the grand coalition, inasmuch as, given an imputation in the core, it is not in the interest of any proper subset of the set of players to break away from the grand coalition to form their own. The Shapley value of the game can be said to reflect the relative bargaining positions of the players, inasmuch as it is determined by each player's contribution to a coalition that he joins averaged over all possible coalitions that he can join (regarded as ordered sets). A uniform distribution of payoffs can be supposed to reflect egalitarian values of the players or, perhaps, their sense of solidarity "against" the experimenter, who in social psychological experiments is sometimes perceived as an alien authority figure, etc.

If the goal of a game experiment is to compare the relative attractiveness of different solutions, it is clearly advantageous to design the game so that the solutions to be compared are disjoint. For example, if the game has a core containing several imputations, it is desirable to have the solutions to be compared with the core lie outside it.

In the experiment to be described, the solutions compared were the core, the Shapley value, and the egalitarian (uniform) imputation. Both of the latter were outside the core.

In addition, another feature was added, which seemed to be of social psychological interest. Namely, the apportionments of the payoffs of a four-person cooperative game were determined by one of the players (the "Dictator") under conditions to be described below. The players had opportunities to "depose" the Dictator and to re-instate him (under conditions to be described). These events, too, suggests interpretations and consequently further hypotheses concerning factors involved in collective decisions.

"The Dictator" is a four-person cooperative game $\langle N,v \rangle$ with $N = \{A,B,C,D\}$ and the following characteristic function:

$v(A) = v(B) = v(C) = v(D) = 0$
$v(AB) = 50; \ v(AC) = 60; \ v(AD) = 40; \ v(BC) = 20; \ v(BD) = 30; \ v(CD) = 10$
$v(ABC) = 110; \ v(ABD) = 80; \ v(ACD) = 70; \ v(BCD) = 90$
$v(ABCD) = 120$

The core of the game is given by
$$x_A = 30; \ 40 \lesseqgtr x_B \lesseqgtr 50; \ 30 \lesseqgtr x_C \lesseqgtr 40; \ x_B + x_C = 80; \ x_D = 10$$

The Shapley value is given by

$$x_A = 36.67; \ x_B = 35; \ x_C = 30; \ x_D = 18.33$$

We note that the Shapley value reveals A to be the "strongest" and D the "weakest" player. We note also that both the Shapley value and the egalitarian solution (30, 30, 30, 30) lie outside the core.

The Rules of the Game

There are two variants. In one the role of the "dictator" in the grand coalition is played by A (the A version), in the other by D (the D version). The following are the rules of the A version.

1. The four roles are assigned to the four players by lot.
2. The rank order of the players is $A > B > C > D$.
3. Every coalition has at its disposal the amount of $v(S)$ given by the characteri

stic function.

4. In any coalition, S, v(S) is apportioned among its members by the player with the highest rank in that coalition. For instance, the joint payoff 90 = v(BCD) is apportioned by B (who can, if he wishes, award a positive amount also to A). During negotiations, agreements over the distribution of v(S) can be made, but the distributor (the highest ranking player in that coalition) is not bound by these agreements.

5. Initially, the grand coalition, N, is assumed to exist. A, the highest ranking player of the grand coalition distributes the 120 points among the four players.

6. If the distribution effected by A is accepted, A remains in the role of distributor in the next round. If the distribution is rejected by at least one of the players, counter-proposals can be made. A counter-proposal accepted by A must be accepted also by the other players. In other words, consensus must always rule the grand coalition. At disbursement, A can nevertheless break the agreement and distribute v(N) as he pleases.

7. If no consensus forms, the grand coalition dissolves, and negotiations are conducted over new coalitions. Any coalition can be formed, whereby the payoffs are indicated in a table, which the players can consult. The payoffs in every coalition are distributed by the highest ranking player in it. Rule 6 governs also the disbursements in the smaller coalitions.

8. After the dissolution of the grand coalition, it can be reconstituted either immediately or later. In that case, A is re-installed in his role as the distributor.

9. The players do not know the number of rounds to be played. However, the last round is announced as such to the players. In the experiment, the number of rounds was fixed to fifteen.

10. A point is convertible to AS 0.20. That is, AS 24.- (maximum) is distributed on each round.

The rules of the D version are identical except that D is substituted for A and the rank order of the players is D > C > B > A.

Some Questions Explored

The experiment was designed as an exploratory study. Consequently, few specific hypotheses were advanced. Instead, we have addressed ourselves to some open-ended questions, hoping that the results of the experiment will <u>suggest</u> (rather

than provide) answers to the questions. From these suggested answers, hypotheses may be formulated to be tested in further studies specifically designed for that purpose. Since the generation rather than the testing of hypotheses was the main aim of the present study, we did not resort to statistical evaluation of the results except occasionally.

The questions related to the results were the following:

1) Of the three solutions of the cooperative game, the core, the Shapley value, and the uniform distribution, which appeared to give the best fit to the average observed payoff distributions?

2) Was the introduction of the "dictator" into what was otherwise a four-person cooperative game in characteristic function form reflected in the distribution of payoffs?

3) Were the results markedly different when A (the "strongest" player) was the dictator than when D (the "weakest" player) was the dictator?

4) Did the average payoff distribution on the last round of a sequence of plays (known to the players to be the last round) differ from the average distribution in previous rounds? In particular, did the dictator take advantage of the opportunity provided in the last round to "take the money and run"?

5) Are there discernible relations between the personality profiles of the players and their gains? In particular between their level of participation in the bargaining phase and their gains?

6) Is their a discernible relation between the personalities of the players and their perceptions of the relative success achieved by themselves and others in the game?

7) Is there a discernible relation between the personality profile of the dictator, his relative gain accumulated during the run, and his behaviour on the last round?

Experimental Design and Procedure

60 male and 60 female students from Vienna participated in the experiment.

Two men and two women participated in each session. There were thus six ways of assigning roles to players with both sexes in all four roles. This was done as shown in Table 1.

Table 1: The six sex-role combinations

| | Role | | | |
Combination	A	B	C	D
1	M	M	F	F
2	M	F	M	F
3	M	F	F	M
4	F	F	M	M
5	F	M	F	M
6	F	M	M	F

M = male

F = female

The 120 subjects constituted three groups.

The control group (Version C): 6 sessions (each of the sex-role combinations once). In this version, there was no dictator. That is, the distributions of payoffs were as determined in negotiations preceding each distribution.

Version A: 12 sessions (each of the sex-role combinations twice). In this version, the hierarchy of the players was A > B > C > D, that is, A was the dictator in the grand coalition.

Version D: 12 sessions (each of the sex-role combinations twice). In this version, the hierarchy of the players was D > C > B > A, that is, D was the dictator in the grand coalition.

At the start of a session, roles were assigned by lot, given a fixed sex-role combination. The players, the Experimenter (E) and the Recorder (R) were seated as shown in Figure 1.

Figure 1: Seating arrangement
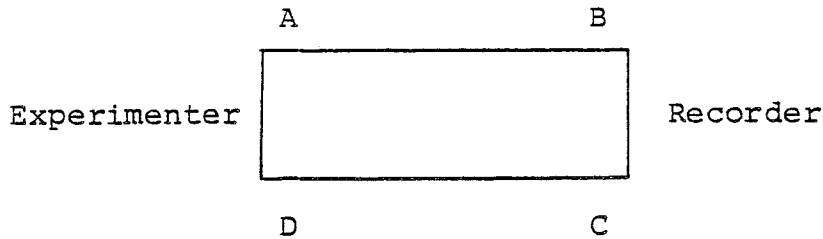
Each player received a card indicating his/her role. The clockwise arrangement was an additional aid to orientation.

Each player received the rules of the game, a table of payoffs, and a purse to put winnings in. Thus accumulated winnings were not visible to the players. At the close of the session, subjects were asked to estimate their and the other players' winnings (see Appendix).

After instructions were given and questions answered, the first round began. During each round, the Experimenter urged the subjects to hold discussions to a five minute limit but did not insist on terminating the discussion if an extension was requested.

In the distribution phase, the Experimenter distributed the payoffs (chips) according to the distributor's instructions. The Recorder kept the protocol of the session and estimated the relative intensity of participation of the players in the negotiations (high or low). The Experimenter and the Recorder checked the total amount distributed. Aside from this, the Experimenter and the Recorder intervened as little as possible.

The game terminated after 15 rounds. The fifteenth round was announced as the last.

The players were asked to fill out a questionnaire (see Appendix).

The chips were converted to money at the rate of AS 0.20 per point. In addition, each player received a fixed fee of AS 100.- for participating in the experiment.

Thereupon all materials were gathered. The subjects were promised information about the purpose of the experiment and the results if they desired to receive them.

Results to be Examined

We will examine the following results.

1) The average payoff distributions related to the experimental conditions. As stated, we are interested in whether these distributions come closest to some game-theoretic solution of the n-person game in characteristic function form (Shapley value, core) or to a uniform distribution suggested by egalitarian values.

2) Frequencies of coalitions related to experimental conditions. How frequently does the grand coalition break up? What is the most frequent alternative?

3) Breaches of contract. According to the rules of the game, the players negotiate agreements about the distributions of payoffs. In Versions A and D, the dictator, who effects the distributions, is not bound by these agreements. If he distributes the payoffs in a way other than agreed upon, we have a breach of contract. We may assume that a breach of contract has a destabilizing effect on the existing coalition.

Now the question arises whether the destabilizing effect, presumably due to the presence of the dictator, is manifested only after the dictator violates an agreement or whether the very presence of the dictator has a destabilizing effect on the grand coalition. Accordingly, we compare the distribution of coalitions in Versions A and D before and after the first breach of contract and these with the distribution of coalitions in Version C. (Since there is no dictator in Version C, breaches of contract do not occur in that version.)

4. Take the money and run. Since the last round is announced as such, the dictator knows that he can appropriate the entire amount accorded to the coalition of which he is the senior member without being subjected to sanctions on the following rounds. It is, therefore, of interest to see how frequently use is made of this opportunity and to assess the relation between this sort of

appropriation or, more generally, of the opportunity to appropriate more than an equal share, and the personality of the player in the role of dictator.

Whether a player in the role of dictator does or does not take the opportunity of appropriating a larger than average amount can, in our estimation, be influenced by two sorts of factors: his situation at the end of the run (whether he is "ahead" or "behind" in his accumulated payoff) and his personal characteristics. Accordingly, we have advanced the following hypotheses:

H_1) The larger is the dictator's "deprivation" at the end of the run (deficiency in accumulated payoff), the more likely he is to benefit himself in the last round.

H_2) The larger the achievement motivation of the player, the greater will be his tendency to take advantage of the opportunity on the last round.

H_3) The larger his affililation motivation, the weaker will be his tendency to take that advantage.

H_4) The larger is his power motivation, the greater will be the tendency to benefit himself on the last round.

Measures of the motivational factors were obtained from the subject's answers on a questionnaire (see Appendix).

5. <u>Further results related to the personality profile of the players.</u> Although "Dictator" was developed not primarily with the aim of operationalizing social psychological hypotheses but rather with the aim of contributing to the discussion of various approaches to the solutions of cooperative games, nevertheless the experiment can be used for analyzing connections among power structures, bargaining behaviour, and the resulting allotments of payoffs, with the view of formulating hypotheses about psychologically relevant determinants of behaviour in a social context.

If we assume that for the most part there is no congruence between the actual behaviour of a player and "rational" behaviour (however the latter is defined), the question arises which psychological variables should enter a description

and/or explanation of the discrepancy.

Traditionally, in situations of this sort one resorts to constructs that relate individual variation of behaviour to different personality characteristics, whereby the latter are to serve as predictors of behaviour in specific situations. However, the underlying concept of constant personality characteristics independent of situation becomes problematic to the extent that on the basis of considerations derived from learning theory, the assumption of constant behavioural dispositions, that is, a tendency of the same or similar patterns of behaviour to appear in different situations over lengthy stretches of time must be questioned. Accordingly, behaviour is assumed to be learned in connection with discriminable stimuli and can therefore be regarded as situation dependent. Representatives of a strict learning-theoretical (behaviouristic) position usually categorically reject the concept of "personality".

In refutation one can, however, point out that considerable differences are observed between persons, which manifest themselves in the consistency with which they behave over different social situations. A solution of this problematic is offered in the form of an assumption of attribution theory, namely that differences can be related to the way the causality of one's own behaviour is judged (Rotter, 1966). Persons that attribute their behaviour predominantly to external factors (that is, ascribe their behaviour to circumstances) will react predominantly according to situation, whereas persons that attribute their behaviour to internal factors (that is, feel themselves to be causes of the behaviour) will tend toward constant behaviour patterns.

If we take these considerations into account in choosing the variables to enter the analysis of game or bargaining behaviour, the attribution tendencies of the players should be determined. In the framework of our experiment, this should be accomplished on the one hand by estimating the determinants of each player's winnings on the external-internal and stable-variable dimensions. On the other hand, the subjects are to fill out a questionnaire designed to distinguish between internal and external control (after Rotter). According to Rotter (1975), following a learning experience, persons develop a tendency toward internal or external attribution.

Further choice of variables was made under consideration of interactions between the imposed conditions of the game, that is, the positions of the individual players, the payoffs available to the different coalitions, and the social situation, marked by the interactions of persons with different motivations taking place in bargaining. The extent of bargaining activity can be regarded as a probably important determinant of the course of negotiation and thus of payoff distribution agreements arrived at by the players. Taking this variable into account is based on the conjecture that apart from the player's position, the results of the negotiations and the associated payoff distribution could depend in large measure on the (verbal) activity of individual players. (This variable will be scaled binarily in the protocol of each round). With regard to the motivation, with which a player enters the game situation, behaviour calculated to maximize own payoffs can be ascribed to the strong influence of achievement need. The same behaviour can be also ascribed to the "need for power". Egalitarian behaviour may be based on predispositions of players to reduce social tensions or dissonance inherent in current interaction structures and can be regarded as an expression of the "need for affiliation".

These three variables, as well as the "locus of control" should be captured by the questionnaire, whereby the striving for dominance and the "need for affiliation" will be measured by corresponding subscales 16 PF of Cattell (1957) . To capture achievement motivation, an item list, following TAT evaluating criteria (after McClelland, 1953) was put together and pre-tested for homogeneity of the underlying properties, with the aid of Rasch's dichotomous logistic model (Rasch, 1960).

Finally, it seems interesting to take into account possible systematic relations between the actual and the subjectively expected payoffs of players. If actual payoffs deviate from those agreed upon in negotiations, this discrepancy may be related to the discrepancy between actual and expected payoffs. In this way, interactions between outcomes of plays are introduced. For this reason, a judgment should be elicited from each player regarding his own and other players' payoffs, and the subjects should not be informed about their accumulated winnings during the course of the game.

All this information should be obtained from the questionnaire presented in the

Appendix .

By way of example, we will now show how the analysis of outcomes should be carried out using psychological variables. According to the argumentation of attribution theory, one could expect that given a connection between personality related disposition and agreements on payoff distributions and assuming a constant effect of these features, the subjects characterized by external control should produce larger variance of outcomes of individual plays. Can such a connection be established on the basis of negotiation results? Do these variables have an effect on the actual payoffs? Is there an interaction between possible discrepancy between distributions agreed upon and those realized and differential effects of personality characteristics?

Does intensity of activity in negotiation have an effect on the results of negotiation or how can each player's payoff be related to those variables? Can differential intensity of activity in negotiation be related to the player's attribution tendencies? If so, can the questions put here be answered in the sense that negotiation activity can be regarded as an expression of different dispositions (internal or external attributions)? Are these connections in any relation with other perceived personality features?

DISCUSSION OF RESULTS

Payoff Distribution

The distributions of average payoffs are shown in Table 2.

Table 2: Payoff distributions

Version A

Group	Total points in first 14 rounds A	B	C	D	Points in 15th round A	B	C	D	Total points A	B	C	D
e10g2A	435	415	440	380	30	30	30	30	465	445	470	410
e10g3A	400	392	386	362	30	30	30	30	430	422	416	392
e15g2A	330	355	325	330	0	20	50	20	330	375	375	350
d10g2A	401	363	388	338	0	30	30	30	401	393	418	368
c15g1A	355	335	390	320	0	90	0	0	355	425	390	320
c15g2A	384	402	402	402	80	10	10	10	464	412	412	412
a15g2A	345	465	355	375	60	20	20	20	405	485	375	395
a10g2A	405	405	395	395	30	30	30	30	435	435	425	425
e15g1A	420	415	415	420	30	30	30	30	450	445	445	450
e10g1A	420	420	420	420	30	30	30	30	450	450	450	450
c10g2A	410	390	390	370	30	30	30	30	440	420	420	400
b15g1A	393	391	393	403	30	30	30	30	423	421	423	433
Sum	4698	4748	4699	4515	350	380	320	290	5048	5128	5019	4805
Per round	28.0	28.3	28.0	26.9	29.2	31.7	26.7	24.2	28.0	28.5	27.9	26.7

Table 2: (Continued)

Version D

Group	Total points in first 14 rounds A	B	C	D	Points in 15th round A	B	C	D	Total points A	B	C	D
e15g3D	425	425	425	395	30	30	30	30	455	455	455	425
d10g3D	430	445	445	290	0	20	20	50	430	465	465	340
c10g3D	388	419	423	410	37	36	37	0	425	455	460	410
c10g1D	455	495	495	115	0	0	0	90	455	495	495	205
b10g3D	380	327	384	339	32	28	39	11	412	355	423	350
a15g3D	430	385	380	385	30	30	30	30	430	415	410	415
b10g2D	420	420	420	420	30	30	30	30	450	450	450	450
b15g3D	406	384	360	290	30	30	30	30	436	414	390	320
d15g3D	370	371	365	274	30	30	30	30	400	401	395	304
d15g2D	380	370	490	390	30	30	30	30	410	400	520	420
a10g3D	420	420	420	420	30	30	30	30	450	450	450	450
d10g3D	395	380	410	405	10	10	90	0	405	390	500	405
Sum	4869	4841	5017	4133	289	304	396	361	5158	5145	5413	4494
per round	29.0	28.8	29.9	24.6	24.1	25.3	33.0	30.1	28.7	28.6	30.1	25.0

Table 2: (Continued)

Version C

	Total points, 15 rounds			
Group	A	B	C	D
c15g3K	458	456	456	420
a10g1K	450	450	450	450
d15g1K	450	450	450	450
b15g2K	450	450	450	450
b10g1K	495	360	495	360
a15g1K	430	394	414	429
Sum	2733	2560	2715	2559
per round	30.4	28.4	30.2	28.4

The strong preference for the egalitarian solution is clearly evident. The only discernible differentation is between player D and the remaining players. D's average share is the smallest in Versions A and D and ties for the last place in Version C.

The prominence of the egalitarian solution cannot be attributed to the presence of the dictator, because it is at least as strong in the control version, if anything even more pronounced. Thus, one might hypothesize that the introduction of the dictator detracts from rather than reinforces the egalitarian solution. (This conjecture will be corroborated by the distribution of coalition frequencies, examined below.)

Turning to the payoff distribution in the last round, we observe that only in two cases out of 24 did the dictator "take the money and run". In Version A, it was B,

who was dictator in coalition BCD; in Version D, it was D, who was dictator in the same coalition. The average distribution in the last round, however, did not deviate markedly from the uniform distribution.

We conclude that egalitarian values were reflected also in a tendency to compensate players who may have been disadvantaged on some rounds. Appropriations of more than equal share by the dictator on the last round can also be explained by "compensation" as will be shown below.

Table 3 shows agreed upon distributions and realized distributions averaged over rounds in which the payoffs were not distributed uniformly. These were examined to see whether differentiation of gains was masked by the many rounds with uniform distributions.

Table 3: Agreed upon and realized distribution, averaged over rounds in which the respective distributions were not uniform

Role	Version A agreed	actual	Version D agreed	actual	Version C
A	23.3	25.6	29.1	28.1	31.8
B	25.0	26.2	31.5	27.8	23.0
C	28.0	25.6	29.5	29.7	30.8
D	21.3	23.1	13.2	18.8	23.0

From Table 3, we see that the average gains of A, B, and C are still approximately equal, while D's average gain is now considerable smaller. Thus, D is apparently discriminated against in both Version A and in Version D.

We see, further, that in Version C, players A and C win on the average more than B and D. It appears also that D, the disadvantaged player, gets slightly more in

Version A and considerable more in Version D in the actual payoff distribution than in the distribution agreed upon in the negotiations. Since discrepancies between agreed upon and actual distributions are due to breaches of contract, it seems that on the average these breaches favour the disadvantaged player.

The difference between the average payoffs of A and C on the one hand and B and D on the other is due to the occasional formation of the two pair coalitions AC and BD, whereby v(AC)=60, v(BD)=30, as appears from Table 4 below.

Finally, we observe from Tables 2 and 3 that the largest average gain in Version A accrues to B and in Version D to C. The differences in average gains of players (except for the small gain accruing to D) are extremely slight and probably not significant. Still the above observation is consistent with the observed dynamics of coalition formation. Namely, when the grand coalition dissolves, the most fre quently excluded member is the dictator. Then B becomes the dictator of the BCD coalition in Version A and C the dictator of the ABC coalition in Version D. The disadvantages of being dictator in the grand coalition does not seem to be carried over to the coalition from which the dictator was excluded.

Frequency of Coalitions

Table 4 shows the occurrence of various coalitions in the three versions.

We note that the overwhelming majority of coalitions in Version C are the grand coalitions. These coalitions occur with the next largest frequency in Version A and with a somewhat smaller frequency in Version D, although still an absolute majority in this version.

This result reinforces the conjecture that the presence of the dictator destabilizes the grand coalition and produces the principal discrepancy in the payoff distributions. Note that the second most frequent coalition in Version A is BCD, i.e., the coalition from which the dictator is excluded. In Version D, on the other hand, the most frequent coalition smaller than the grand coalition is ABC, again the coalition from which the dictator is excluded. Moreover, coalition ABC in Version D occurs with greater frequency than coalition BCD in Version A. The reason is apparent. In view of the characteristic function of the game, D is the

Table 4: Frequency of occurence of various coalitions

Version A

Group	ABCD	ABC	ABD	ACD	BCD	AB	AC	AD	BC	BD	CD
				Number of coalitions observed							
e10g2A	13	1									
e10g3A	9	1	1		2		1			1	
e15g2A	3	2	3	1	3		1	1	1	1	
d10g2A	5	3	1		2		3			3	
c15g1A	5	1			3	1	3	1	1	3	1
c15g2A	10	1			3						
a15g2A	8	2			4						
a10g2A	12	1	1								
e15g1A	13	1									
e10g1A	14										
c10g2A	10				4						
b15g1A	11			1	2						
Total	113	13	6	2	23	1	8	2	2	8	1
%	63.1	7.3	3.4	1.1	12.9	0.6	4.5	1.1	1.1	4.5	0.6

Table 4: (Continued)

Version D

	Number of coalitions observed										
Group	ABCD	ABC	ABD	ACD	BCD	AB	AC	AD	BC	BD	CD
e15g3D	13	1									
d10g3D	7	6			1						
c10g3D	9	5									
c10g1D	3	9			2						
b10g3D	3	7	1			1	1	1	1	1	1
a15g3D	9	2	2				1			1	
b10g2D	14										
b15g3D	8	2		2		1		1	1		1
d15g3D	4	3	1	1	3		1	1	1	1	
d15g2D	11	2			1						
a10g3D	14										
d10g1D	5	5			1	1	2			2	1
Total	100	42	4	3	8	3	5	3	3	5	3
%	55.9	23.5	2.2	1.7	4.5	1.7	2.8	1.7	1.7	2.8	1.7

Table 4: (Continued)

Version C

Group	ABCD	ABC	ABD	ACD	BCD	AB	AC	AD	BC	BD	CD
			Number of coalitions observed								
c15g3K	14	1									
a10g1K	15										
d15g1K	15										
b15g2K	15										
b10g1K	12						3			3	
a15g1K	11	1			1	1	1			1	1
Total	82	2			1	1	4			4	1
%	86.3	2.1			1.0	1.0	4.2			4.2	1.0

weakest player in the sense that the cost of excluding him is the smallest. If the tendency is to exclude the dictator, the tendency is stronger when the dictator is the most dispensable player. We now see the reason why D does worst in Version D. In that version, he is both the weakest player and the dictator hence most likely to be excluded.

In Version C, three-person coalitions are quite rare. Those that occurred in two out of 90 rounds (ABC and BCD) are the most profitable. Also the pair coalition AC, which awards the same gain per capita as the grand coalition (30), occurred four times. This left B and D no choice but to form their own paired coalition and explains the four occurrences of the "poor" coalition BD. The occurrence of the even poorer coalition AB and its complement, the poorest coalition CD remains unexplained on "efficiency" grounds.

We note that the infrequent dissolution of the grand coalition in Version C is

consistent with group rationality, since in all cases but one the players who left the grand coalition suffered no loss, and in the case of ABC realized a larger per capita gain than in the grand coalition. On the other hand, had they been motivated by greater gain alone, coalition ABC would have been observed with the greatest frequency. Nevertheless, this coalition was observed only twice in 90 rounds.

We conclude that egalitarian values, insuring the stability of the grand coalition and a uniform distribution of payoffs, was especially strong in Version C, where there was no dictator.

Effects of Breaches of Contract

Frequencies of coalitions before and after the first breach of contract are shown in Table 5.

Table 5: Various types of coalitions observed before and after the first breach of contract

Version A

Coalition type	Up to first breach inclusive		After first breach	
	n	%	n	%
Grand	59	73.8	54	61.4
3-Person with Dictator excluded	6	7.5	18	20.5
3-Person with Dictator included	9	11.3	11	12.5
2-Person	6	7.5	5	5.7
Total	80	100	88	100

Table 5: (Continued)

Version D

Coalition type	Up to first breach inclusive		After first breach	
	n	%	n	%
Grand	70	68.7	30	45.4
3-Person with Dictator excluded	21	20.6	21	31.8
3-Person with Dictator included	8	7.8	7	10.6
2-Person	3	2.9	8	12.1
Total	102	100	66	100

From Table 5 we see that there is a distinct drop in the proportion of grand coaltions in Versions A and D following the first breach of contract. However, even before the first breach, the proportion of grand coalitions is lower in Versions A and D than in Version C. This suggests that the presence of the dictator alone may have a destabilizing effect on the grand coalition, which is aggravated by the first breach of contract.

Distribution of Runs with 0, 1, 2, etc. Breaches of Contract

Is there a contagion effect in breaches of contract? In other words, does the occurrence of a breach of contract facilitate successive occurrences? To see this, we examine the distribution of runs (i.e., subject groups), in which 0, 1, 2, etc. breaches of contract were observed. If the incidence of contract breaches occurs entirely at random (a null hypothesis), then this distribution ought to be well approximated by the Poisson distribution. Departure from the Poisson distribution suggests either heterogeneity of subject groups or a positive

contagion effect. The observed distributions are shown in Table 6.

From Table 6 we see that the distribution is very nearly Poisson in Version A but departs pronouncedly from the Poisson distribution in Version D. In the latter case the distribution is fitted considerably better by the negative binomial distribution.

Table 6: Numbers of groups in which indicated numbers
          of contract breaches occurred.

Version A

Number of breaches	Observed number of groups	Expected (Poisson)[1]
0	3	2.9
1	4	4.1
2	3	2.9
3	1	1.4
4	1	0.5
over 4	0	0.2
Total	12	12.0

1) $\lambda = 1.42$

Table 6 : (Continued)

Version D

Number of breaches	Observed number of groups	Expected (Poisson) [1]	Expected (Negative bionomial) [2]
0	5	1.9	3.4
1	3	3.5	2.5
2	1	3.2	1.5
3	0	2.0	1.0
4	1	0.9	0.7
5	1	0.3	0.5
over 5	1 (8)	0.1	2.4
Total	12	12.0	12.0

1) $\lambda = 1.83$

2) $p = 0.281$; $r = 0.718$

Evidence for a difference in distributions is not strong considering the small sample of subject groups. Nevertheless a conjecture is suggested. Since D is a "weak" dictator, more dispensable than A in the role of dictator, D could be expected to be more reluctant to break the contract for the first time. However, once he does break it and is punished by being excluded from a coalition, thus suffering a loss, he may be tempted to break it again (when the grand coalition re-forms and he is re-instated as dictator), in order to make-up for his loss. Admittedly, this reasoning is not very convincing, since, if it is applied to the A Version, one would expect a contagion effect here also. If A is not frequently excluded after he breaks a contract (because it is expensive to exclude him), he may be also encouraged to break contracts after he has broken a contract for the first time with impunity. Of course, heterogeneity of subject groups may also

lead to departures from the Poisson distribution. On this basis, however, the difference between the distributions in the A and the D versions cannot be explained. We emphasize again that the main purpose of the experiment was not to test hypotheses but to see what hypotheses are suggested by the results; then to select the most interesting or challenging of these to be tested in experiments especially designed for that purpose.

A breach of contract does not necessarily mean that the dictator awards himself a greater share than agreed upon. He could also take for himself the share that had been agreed upon (or even a smaller share) and distribute the remainder of the joint gain in some way that seems to him more fair than the agreement. Table 7 shows that this may indeed have been the case.

Table 7: "Egoistic" and "Altruistic" breaches of contract

Breaches	Version A	Version D	Total
"Altruistic"	8	4	12
"Egoistic"	9	18	27

We observe that in Version A breaches of contract, whereby the dictator gets no advantage are almost as frequent as those whereby he does. In Version D, on the other hand, "altruistic" breaches of contract are considerably less frequent than "egoistic" ones. Can this difference (if it is significant) be explained?

Assume that "altruistic" breaches of contract entail favouritism toward some player in the expectation that the latter will "stand by" the dictator when and if he is deposed, for instance, form a coalition with him to repay the favour. Examining the protocols, we see that in Version A, the dictator systematically favours D, the weakest player. This strategy, however, does not pay in the long run: the average gain of those dictators who break contracts altruistically is still below the average gain of those who break contracts only egoistically. Considering the results in Version C, it seems, therefore, that the tendency toward egalitarian distribution persists also in Version A, and that the dictator contri

butes to that tendency (as reflected in sytematic favouritism toward D.)

Turning to Version D, we see that in that version the dictator and the player favoured are one and the same (D). This may account for the greater relative frequency of "egoistic" breaches of contract in Version D.

The difference in the dynamics of the two versions can be clearly seen in Figure 2.

We observe that in Version A inequality of the distribution (measured by the ratio of the standard deviation to the mean of the gain) after an initial rise steadily declines. Presumably, the dictator contributes to this equalization by assistance to the weakest player D. In Version D, on the other hand, where the dictator is the weakest player and must rely on his own efforts to effect an equalization, success is not pronounced. To be sure, there is a decrease of inequality following the initial increase, as in Version A, but thereafter inequality steadily rises. Evidently D's efforts to increase his share are frequently punished by exclusion from the grand coalition, as we have already seen from the analysis of coalition formation.

Next we examine the position of the dotted curve relative to the solid curve in Figure 2. Our conjecture was that the players try to reduce inequality of accumulated payoffs by the agreements reached in negotiations. On the other hand these attempts are opposed by the dictator. Consequently we expect the solid curve to lie above the dotted curve. From Figure 2 we see that with only few exceptions the dotted curve lies above the solid curve. Since the dotted curve represents the group's projected (average) result and the solid curve reflects the dictator's decision, the fact that the solid curve most of the time lies below the dotted curve indicates that the dictator for the most part tends to reduce inequality even more than the group intends to do.

Take the Money and Run

The correlation to be examined first is between the dictator's accumulated deficiency ("deprivation") and the amount appropriated on the last round. The deficiency will be measured by the difference between the dictator's accumulat-

Figure 2: Inequality of average winnings
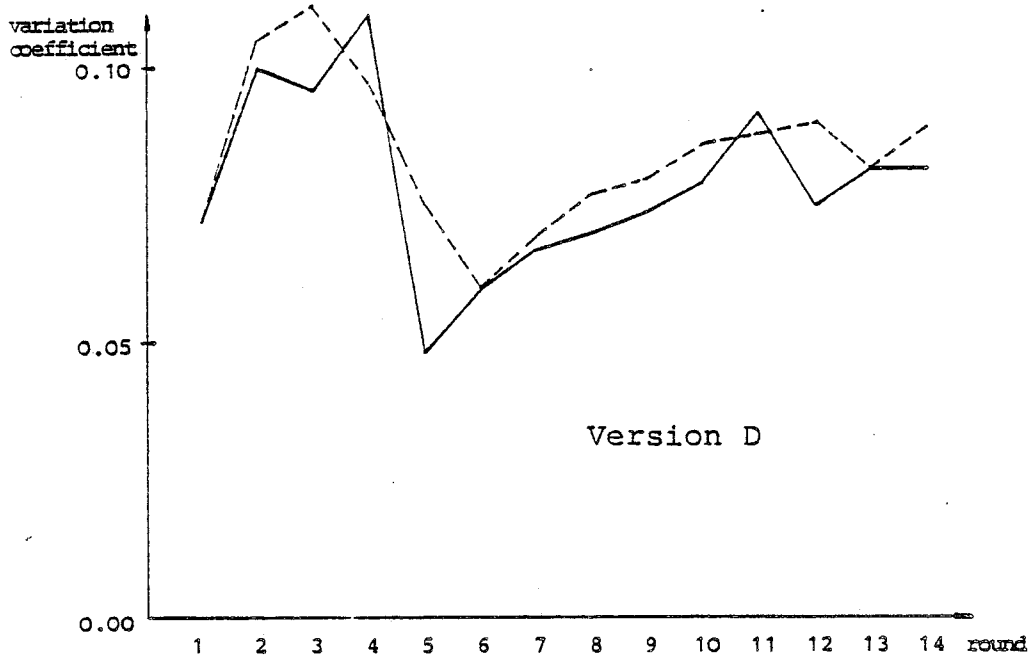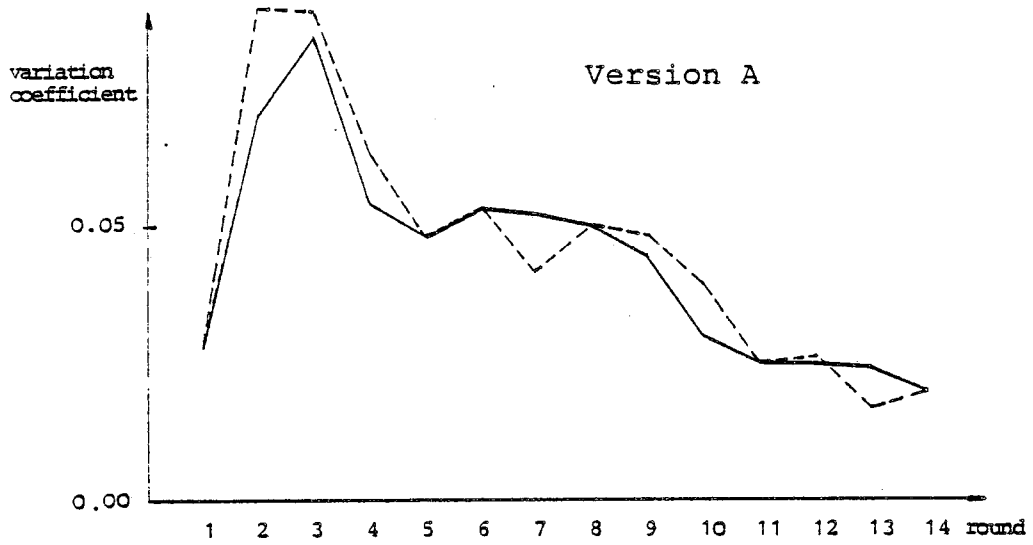
_____ Inequality of total winnings to running
round inclusive

------ Inequality of total winnings to running
round less one + agreed upon distribution
in running round

ed payoff and the average payoff in the fourteen round before the last. The amount appropriated will be measured as the excess of the amount awarded to self over the average payoff on the last round. This correlation turns out to be $r=0.48$, significant at the 0.01 level. Thus, we regard H_1 above as confirmed. As we shall see below, this relation remains observed also after personality characteristics are taken into account.

The value of the correlation coefficient remains quite stable when the variables are measured in another way. For example, if we take as our index of deprivation the sum of differences between the maximal payoff and that of the dictator in each of the fourteen preceding rounds; and our index of "the use of power" as the difference between the dictator's payoff and the largest of the other three payoffs on the last round, we obtain $r=0.51$. If we use the difference between the dictator's payoffs and the minimum of the remaining payoffs, we get $r=0.46$.

We next examine the tendency of the dictator to appropriate more than an equal share of the gain on the last round and his/her personality characteristics, assessed independently by his/her behaviour in the game. On the basis of behaviour, we define a double dichotomy of players in the role of a dictator on the last round: the "deprived" and the "non-deprived"; the "appropriators" and the "non-appropriators". The "deprived" are those whose accumulated gains during the first fourteen rounds were less than the average for that run. The "non-deprived" are the remaining players. The "appropriators" are those who awarded themselves more than an equal share on the last round. The "non-appropriators" are the remaining players. Thus, four types of players in the role of dictator on the last round are defined.

Type I ("altruistic"): the deprived non-appropriators.
Type II ("social"): the non-deprived non-appropriators.
Type III ("compensators"): the deprived appropriators.
Type IV ("egoistic"): the non-deprived appropriators.

In addition, each subject is assigned three scores on the basis of his answers to the relevant questions on the questionnaire. These scores are the subject parameter estimates of the dichotomous logistic Rasch model (Rasch, 1960).
NACH: this score presumably measures intensity of the subject's need for

achievement (skills, success, etc.)

NAFF: this score presumably measures the intensity of the subject's need for affiliation (approval of others, affection, good personal relations).

NEPO: this score presumably measures the intensity of the subject's need for power (prestige, domination of others, etc.).

Table 8 shows the average NACH, NAFF and NEPO scores of the subjects in the above mentioned four behavioural categories.

Table 8:   Behavioural types and personality scores

Type	NACH	NAFF	NEPO	N
I	0.25	0.97	-0.46	5
II	0.32	-0.52	0.13	10
III	0.95	-2.04	-0.04	6
IV	1.46	-0.99	0.28	3

We see from Table 8 that "altruistic" dictators score highest on the NAFF dimension and lowest on the NEPO dimension, as expected. Further, all other types score highest on the NACH dimension and lowest on the NAFF dimension. Finally, the NACH score increases monotonically with the behaviourally manifested egoism, and except for one reversal, the NAFF score decreases with the degree of behaviourally manifested egoism. This relationship is also in accord with intuited expectation. The NEPO score, on the other hand, shows no discernible trend related to the degree of egoism.

Is "Success" in Playing "Dictator" Related to the Personality of the Player?

So far we have compared average payoffs accruing to the different roles in the game. Thus, A, B, C, and D represented "composite subjects" in the respective roles. We now ignore the roles (to which the subjects were randomly assigned) and compare the average payoffs accruing to individuals or groups characterized

by personality profiles.

For our personality measures we take the three "need" scores, NACH, NAFF, and NEPO, and the degree of internal attribution of control (as against external attribution). In addition, we will relate the average gains to the intensity of the subjects' activity, ACT, during the negotiations. This behavioural variable was measured by the relative amount of talking done (high or low) as judged by the Recorder.

Correlations between absolute gains of groups and the mean values of NACH, NAFF, NEPO, and ACT within the groups are shown in Table 9.

Table 9: Correlation between group gains and their mean scores on indicated measures

Measure	Correlation
NACH	-0.291^{*}
NAFF	0.123
NEPO	0.106
ACT	-0.403^{*}

$*$ $p < 0.05$

We note significant negative correlation between average group gain and average NACH and average ACT scores. These are easily explainable. The group gain depends on the frequency of the grand coaliton, which brings the highest group gain. On the other hand, a predominance of achievement oriented players and players who "bargain hard" (as probably reflected in high ACT scores) presumably destabilized the grand coalition, thus driving the group gain down.

Correlations between group gains and the heterogeneity of groups with respect to the personality and activity variables are shown in Table 10.

Table 10:   Correlations between group gains and
            their heterogeneity[1] with respect to
            indicated measures

Measure	Correlation
NACH	-0.367^*
NAFF	0.320^*
NEPO	0.137
ACT	-0.389^*

1) Standard deviation of within group scores

* p < 0.05

We note that three of the correlations are significant. Since group gain is determined by the stability of the grand coalition, it appears that heterogeneity of groups with respect to the strength of achievement motivation and also with respect to participation in negotiations has a destabilizing effect on the grand coalition. Curiously, heterogeneity with respect to need for affiliation appears to have a stabilizing effect.

The results related to NACH heterogeneity and to activity would be consistent with those related to average NACH and activity scores, if homogeneity of NACH and ACT scores were associated with low levels in all four players. This is reasonable in the case of activity scores, since stability of the grand coalition is probably associated with minimum discussion. In contrast, the result related to homogeneity with regard to the NAFF score would be consistent with the result related to the average score if the presence of only one or two players with high NAFF scores had a stabilizing effect on the grand coalition. This conjecture seems interesting to us, but of course it is not supported by substantial evidence in the present context.

Correlations between gains and individual personality characteristics and activity are shown in Table 11.

Table 11:   Spearman rank order correlations between gains
and individual personality characteristics and
activity. Relative gains are with respect to
other players in the same group (all versions).

Measure	Correlation with absolute gain	Correlation with relative gain
NACH	0.152*	0.048
NAFF	0.153*	0.161*
NEPO	0.148*	0.145*
ACT	0.019	-0.166*

* $p < 0.05$

Although six of the eight correlations are significant in the pooled population, the results are not easy to interpret, since the gains correlate positively with all three "need" scores. More information could be obtained by examining the correlations of the "need" scores with each other. On the other hand, the negative correlation between gain and intensity of activity is interesting. Possibly this correlation reflects merely the fact that the dictator, who, on the average, gets less, especially when he is D, does more talking than the others (if only because he has to announce the distribution every time). On the other hand, the negative correlation of gain and activity may apply to all players. If this is the case, we still do not know whether the player who talks most is disfavoured or whether the disfavoured player talks more in trying to improve his condition.

No significant correlations were observed between individual gains and sex, nor with locus of control. Nor were significant correlations observed between locus of control and estimates of others' winnings or with attributions of own or of others' winnings to internal or external factors.

Breaches of Contract and the Dictator's Personality Profile

Next, we examine relationships between the personality profile of the dictator and his tendency to break the agreement arrived at in negotiations. The following questions come to mind.

1) Does the dictator who breaks the contract for the first time differ with respect to his motivation scores from those who do not?
2) Is there a corresponding difference between dictators breaking agreements in any round and those who never break an agreement?
3) Is there a relationship between the frequency of contract breaches and the personality profile of the dictator?

Answers to 1) are suggested in Table 12.

Table 12: Average normalized (Z) scores on indicated measures of dictators who were first to break a contract (Versions A and D).

Measure	Z-score
NACH	-2.413[*]
NAFF	1.52
NEPO	-0.79

[*] $p < 0.05$ (U-Test)

We conjecture that dictators with high achievement motivation scores are more likely to be the first to break the agreement.

Answers to 2) are suggested in Table 13

Table 13: Average normalized (Z) scores on indicated
measures of dictators who broke contracts at
any time during a run.

Measure	Version A Z-score	Version D Z-score
NACH	-4.05*	-2.46*
NAFF	2.67*	0.90
NEPO	1.12	-0.68

* p < 0.05 (U-Test)

It appears from the table that in both versions high achievement motivated dictators tend to break agreements at some time. In version A, in addition, a high affiliation need is reflected in a tendency not to break agreements.

Finally, answers to 3) are suggested in Table 14.

Table 14: Rank-order correlations between number of contract breaches and scores on indicated measures

Measure	Version A Correlation	Version D Correlation
NACH	0.27	0.21
NAFF	-0.60*	-0.18
NEPO	0.29	0.08

* p < 0.05

The only significant correlation is between affiliation need and the frequency of contract breaches: dictators with high NAFF scores tend to break agreements less frequently. This result is in accord with intuited expectations.

Concluding Remarks

The most conspicuous effect observed in the experiment described here was the prominence of the egalitarian distribution. Bias in this direction was expected on the following grounds: (1) egalitarian distributions would be in accord with the ideological predilections prevalent in the population from which the subjects were drawn; (2) it was conjectured that the presence of the dictator would create a pressure toward "solidarity" among the subjects and with it a pressure for egalitarian distributions. The actually observed "egalitarian" effect was greater than expected. However, it could not be ascribed to the presence of the dictator, because it was even stronger in the control groups, in which there was no dictator. In view of the fact that the results of experiments with cooperative games (cf. Kalisch et al., 1954; Maschler, 1965, Kahan and Rapoport, 1974; Horowitz and Rapoport, 1974) usually reflect some feature of the characteristic function as a differentiation of average individual payoffs, the strong egalitarian bias observed in the control groups in our experiment has to be attributed to the characteristics of the subject population.

Of course, the conclusion can be justified with some confidence only if our results are confirmed by results obtained in an analogous experiment with subjects drawn from another population. A corresponding replication is thus indicated.

It was, perhaps a mistake to preserve the dictatorial structure also in smaller coalitions. Besides inducing complications into the rules (always undesirable in game experiments), the design may have adumbrated the original goal of our experiment, namely to pit the cost of deposing the dictator (occasioned by the break-up of the grand coalition) against the attractiveness of opportunities presented in bargaining unencumbered by the presence of the dictator. In retrospect, it seems to have served the purpose of the experiment better if the choice before the subjects on each round had been (a) to depend on the dictator's sense

of fairness or (b) to play every man for himself at the cost of having less to distribute. Unfortunately, unable to follow all the variants of the original design that may suggest themselves in the light of results, we must decide between a new variant and an exact replication with different subjects.

It stands to reason that the strong egalitarian bias masked many other possibly interesting effects, in the first instance those related to individual personality differences. On this score, differentiated results were disappointingly few. On the other hand, the paucity of effects attributable to individual personality differences in experimental games is in accord with observations in most experiments with games. Time and again it turns out that the structure of an experimental game and the roles assumed by the subjects have a much stronger influence on the outcomes than individual personality differences.

Exceptions may be forms of behaviour clearly encouraged or discouraged by the structure of a particular game, as a reflection of certain personality characteristics. In our case, effects of this sort were observed in the "take the money and run" situation. In contrast, "success" in playing the game (as reflected in average payoffs accruing to individuals rather than roles) remained apparently practically uninfluenced by individual personality characteristics. This was, in our opinion, to be expected, first again because of the "masking" effect of the egalitarian bias, second because the allotment by the dictator may have dampened differentiation due to bargaining, third because the bargaining situation itself in a four-person game is much too complex to provide a context in which individual bargaining abilities could be related (as they are for example, in a two-person bargaining game).

APPENDIX

Questionnaire

1) Age

2) Please indicate your occupation or place of study and area of study.

3) Sex.

4) My role in the game (A, B, C, D).

Please answer the following questions for yourself as well

5) Estimate the winnings of each player.

A has won ... points

B has won, etc.

6) How do you judge the satisfaction of each player with the results?

A is satisfied with his winnings: yes o

                                      no o

B is satisfied etc.

7) What, in your opinion, was the reason for the way each player came out? Please indicate only one alternative per player.

For A:

His/her ability to negotiate	o
His/her lack of ability to negotiate	o
His/her favourable position in the game	o
His/her unfavourable position in the game	o
He/she tried especially hard to win much	o
He/she did not try hard enough	o
He/she was lucky	o
He/she was unlucky	o

Same for B,C, and D

Directions for further questions

On the following pages you will find statements about different behaviour patterns, attitudes, and interests. You can react either by "agree with" or "disagree with". There are no right or wrong answers, because every person has a right to his/her own views. Please answer in accordance with your own views.

Please keep in mind the following points:

1) Do not think of the impression your answer may make. Rather answer according to your personal inclination. Some questions may seem to you to be rather personal. Keep in mind, however, that your answer will be kept absolutely confidential.

2) Do not spend much time thinking about each statement. Rather give the answer that occurs to you immediately. Of course - all particularities cannot be taken into account in these short questions. So much may not fit you well. Nevertheless mark one or the other answer, the one that fits you better.

Yes/No

1) I frequently underestimate my potential.

2) Most students do not know how often their marks are influenced by chance.

3) Many unfortunate events in life are at least partially a matter of fate.

4) In my circle of friends, professional activity is not regarded as very important.

5) If I feel I can solve a problem alone, I do not want to be helped even if this would save me time.

6) The ability to make people do the right thing depends on a special gift and has nothing to do with luck.

7) I believe that I am quiet and polite rather than energetic.

8) Success depends primarily on effort.

9) Most people would be happier if they were closer to other people and did as the other did.

10) I have qualities in which I feel I am superior to most others.

11) The number of friends one has depends on how nice one is.

12) Sometimes, I tell things to strangers that seem important to me, even if I am not asked to do so.

13) With regard to global politics, most of us are victims of forces, which we neither understand nor control.

14) One should guide one's life according to the guide lines of one's own social level rather than according to one's own opinion.

15) When I intentionally lie to some one, I am reluctant to look him/her in the eye.

16) I gladly undertake a task in preparing or carrying out an event.

17) I dislike people who are sure of themselves and behave as if they were superior to every one else.

18) What happens to me is a consequence of my own actions.

19) I find it easy to make my own plans.

20) It disturbs me to be thought of as unconventional or strange.

21) It makes little sense to try to be pleasant to others. One is either liked or disliked.

22) Competitive situations are a burden rather than a incentive for me.

23) If a task I started turns out to be very difficult, I want to accomplish it at all costs, even if it demands more time than I thought it would.

24) I speak with a very soft voice.

25) It is not good to plan far ahead, because the outcome will often depend on luck anyway.

26) I am known as some one full of ideas, one who has something to contribute to almost any problem.

27) Often tossing a coin is as good a way of making a decision as any.

28) When I think some one deserves it, I make sarcastic remarks.

29) In the end, one gets the recognition one deserves.

30) No matter how hard people try to prevent them, there will always be wars.

31) My friends probably think that it is hard to really get to know me.

32) Many of my acquaintances do better than average in their fields of activity.

33) In school there was always a direct connection between my effort and my marks.

34) In the last analysis, the good and the bad things in life balance out.

35) I would rather be told what to do than find out for myself.

36) Professional success comes with hard work. Luck has nothing to do with it.

37) Being better than others is not very important to me.

38) If I really want something, I attain it.

39) With some effort one could root out political corruption.

40) I do not feel comfortable in a task, which requires quick action affecting the freedom of others.

41) People who are unable to make others like them simply do not know how to get on with people.

42) I could imagine that others have often called me behind my back an arrogant stuck-up person.

43) I get as much stimulation reading a book as discussing the same theme with others.

44) Things never turn out so well when I trust to luck as when I decide to follow a

certain course.

45) The world is ruled by a few persons, and the "little man" can do nothing about it.

46) When I was at school, the questions on examinations had so little to do with what was learned that it made no sense to prepare for an examination.

47) I often feel that I cannot influence what will happen to me.

48) It is important to me to win in parlour games where the outcome depends on the abilities of the players rather than on chance.

49) Without a favourable opportunity, no one attains a leading position.

50) There is no such thing as luck.

51) I would ralther enjoy life quietly in my own way than be admired for my success.

52) If it is useful to others, I do not mind undertaking a menial task that others look down upon.

53) In the last analysis it is a people's own fault if it is badly ruled, whether on the national or on the community level.

Remark

NACH scale: items no. 1, 4, 5, 8, 22, 23, 32, 37, 38, 48.
NAFF scale: items no. 9, 14, 16, 20, 21, 31, 43, 51.
NEPO scale: items no. 7, 11, 12, 15, 17, 24, 26, 28, 35, 40, 42, 52.
Internal-external control scale: items no. 2, 3, 6, 10, 13, 18, 25, 27, 29, 30, 33, 34, 36, 39, 41, 44, 45, 46, 47, 49, 50, 53.

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