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IDENTIFYING DOMINANT ALLOCATION STRATEGIES OF INDIVIDUALS IN THE MINIMAL GROUP PARADIGM

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ABSTRACT

I describe a simple method which makes it possible, on the basis of measured strategy pull scores in a given minimal group experiment, to identify and also visually display the dominant distribution strategies of individual participants. In a validation study (N = 32), I (1) compared these dominant strategies with the self-reported distribution strategies of the participants and (2) assessed their consistency across different Tajfel matrix types. As it turned out, the dominant strategies, particularly the consistent ones, were highly congruent with the participants' subjective strategies. I argue that dominant strategies are less ambivalent and psychologically more valid than pull scores, although they are derived from the latter, and that this type of analysis, with its focus on interindividual differences, has the potential to stimulate new, interesting research questions.

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INTRODUCTION

The minimal group paradigm developed by Tajfel and associates (e.g., Tajfel, Billig, Bundy & Flament, 1971) has stimulated much empirical research and theorizing in the field of intergroup relations, in particular with respect to intergroup discrimination. It denotes a situation where participants are initially categorized into "minimal" groups that lack most of the features characteristic of real groups, that is, personal acquaintance of the group members, evolved group structure and norms, and common goals. In fact, all the participants know is that they belong to one of (mostly) two groups, as a result of an arbitrary group categorization procedure. At some later point in time, the categorized participants have the opportunity to allocate resources (e.g., money or points) to members of their own group and members of the other group (but not to themselves). Usually, they exhibit ingroup bias, that is, they allocate more resources to ingroup members than to outgroup members (see overviews by Brewer, 1979; Diehl, 1990; Mullen, Brown, & Smith, 1992; Turner, 1978).

Beyond this general finding, special attention has been devoted to the more detailed identification of the distribution principles guiding the participants' allocation decisions. To this end, researchers have designed specific distribution matrices to assess, for example, the participants' reliance on a maximum differentiation principle (MD, also variously called relative ingroup favoritism or winning), which means that the participant seeks to maximize the difference in resource allocations in favor of the ingroup, regardless or even at the expense of the absolute amount of resources allocated to the ingroup. In general, the impact of such distribution principles or strategies is measured through contrasting them with other possible strategies that could be followed on a given distribution matrix, for example, fairness (F), maximizing the joint payoff of both groups (MJP), or maximizing the ingroup payoff (MIP). The specific contrast depends on the construction principle of the matrix, and the units of measurement for the impact of the different strategies on one another are the so-called pull scores, which in essence reflect the degree to which the realization of one strategy keeps the participants from realizing another strategy (i.e., "pulls them away" from the other strategy; see, e.g., Aschenbrenner & Schaefer, 1980; Blank, 1997; Bornstein et al., 1983; Bourhis, Sachdev & Gagnon, 1994; Branthwaite, Doyle & Lightbown, 1979; Tajfel et al., 1971; Turner, 1983; Turner, Brown & Tajfel, 1979; for detailed descriptions of the most commonly used matrices and the procedures for calculating the pull scores of various strategies).

An important and sometimes critically discussed (e.g., Aschenbrenner & Schaefer, 1980) feature of the usual pull score analysis is that it focuses on mean pull scores. This makes it impossible to judge (unless one has access to the raw data) whether a pull score that has been calculated from the participants' matrix allocations in a minimal group experiment reflects the impact of a distribution strategy that has been pursued by all the participants to a certain degree or by only some of the participants but to a maximal degree. This, however, makes an enormous difference with respect to the psychological interpretation of the results: It is the question whether some theoretical explanation (e.g., that pursuing a MD strategy reflects a striving for a positive social identity; Turner, 1975; Tajfel & Turner, 1986) applies to all participants or to only some of them. In the latter case, different theoretical conclusions might have to be drawn with respect to the other participants. Also, one would have to ask the additional question why some people behave in one way and others, maybe, in a completely different way in the same situation. In short, the focus shifts from an overall assessment of the relative importance of distribution strategies in the minimal group situation to interindividual differences in the adoption of such strategies and the reasons for these differences.

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In this article, I present a method that makes it possible to identify the dominant distribution strategies of individual participants, via calculations based on the traditional pull scores. Thus, the method is not revolutionary in the sense that a completely new form of analysis would be created from scratch. Instead, it builds on the traditional analysis but extends it in a few important respects. Accordingly, I begin this exposition with a more detailed explanation of the pull score analysis, using the matrix type MD vs. MIP & MJP as an example. Then, I describe how the pull scores calculated from participants' allocations on this matrix type can be visually displayed in a matrix-type-specific strategy space. This leads us directly to the identification of dominant strategies, either visually from certain critical regions in the strategy space or by a simple arithmetical rule that compares the pull scores of relevant strategies. Following that, to ensure the utility of the dominant strategies approach proposed here, I demonstrate the validity of the identified dominant strategies through (1) comparing them to the participants' self-reported strategies and (2) comparing them across different matrix types that test different combinations of strategies, using the data of an empirical minimal group experiment as an example. After briefly commenting on issues of statistical testing, the general discussion section focuses on the benefits of the dominant strategy analysis presented here and on possible future developments.

Calculating Pull Scores from Reward Allocations in Matrices

An often employed matrix is the one designed for contrasting the impact of the MD strategy on a combination of the MIP and MJP strategies (Tajfel et al., 1971). Table 1 shows a well-known numerical version of this matrix type. Each row represents possible payoffs for one person who is identified only by his or her number and group membership. The participants are instructed to choose one of the matrix columns, each representing a different combination of payoffs for the two persons. The logic behind the construction of the matrix is that the choice of a certain column realizes one or more strategies to a larger or smaller degree. Let us first concentrate on part (a) of Table 1. Here, the payoffs for the ingroup member appear in the lower row and those for the outgroup member in the upper row. In this situation, all three of the considered distribution strategies (MD, MIP and MJP) converge. They are realized to a maximal degree if the participant chooses the rightmost column, and to a minimal degree if the leftmost column is chosen. Accordingly, all columns can be scored along this continuum as indicated in the row underneath the matrix. A hypothetical participant's choice as indicated by the asterisk in part (a) of Table 1 would thus be assigned a score of ten.

Now consider part (b) of Table 1. Here, the row assignments of the ingroup and outgroup member are reversed, leading to a completely different situation. Most importantly, the strategies no longer converge. Instead, a maximal realization of MD implies a minimal realization of MIP and MJP and vice versa. Accordingly, our hypothetical participant's choice in part (b) of Table 1 leads to different (i.e. opposite) strategy realization scores as given in the two rows underneath the matrix (specifically, a score of nine for MD and a score of three for MIP and MJP).

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Table 1. Matrix Designed for Assessing the Impact of Maximum Difference (MD) on a Combination of Maximum Ingroup Payoff (MIP) and Maximum Joint Payoff (MJP)

(a)													MD
													MIP
											*		MJP
Person No X from group ... **[O]**	7	8	9	10	11	12	13	14	15	16	17	18	19

Person No Y from group ... **[I]**	1	3	5	7	9	11	13	15	17	19	21	23	25
Score (MD + MIP & MJP)	0	1	2	3	4	5	6	7	8	9	**10**	11	12

(b)	MD			*									MIP MJP
Person No Z from group ... **[I]**	7	8	9	10	11	12	13	14	15	16	17	18	19
Person No U from group ... **[O]**	1	3	5	7	9	11	13	15	17	19	21	23	25
Score (MD)	12	11	10	**9**	8	7	6	5	4	3	2	1	0
Score (MIP & MJP)	0	1	2	**3**	4	5	6	7	8	9	10	11	12

Note: The two persons are assigned to one of the two groups (ingroup [I] and outgroup [O], from the perspective of the participant) into which the participants were categorized, thereby making the above strategies consistent with or opposed to each other. The strategy designations as well as the ranks corresponding to the degree of realization of a given strategy are not displayed in the matrices given to the participants. The asterisks indicate hypothetical choices of a participant.

Let us turn now to the calculation of the pull scores. As explained above, pull scores reflect the degree to which the realization of one strategy (or combination of strategies) detracts the participants from realizing another strategy (or combination of strategies). This logic translates strictly into the calculation of the pull scores. Consider first the "pull" of MD on MIP & MJP. In the convergent version of the matrix (part (a) of Table 1), the realization of MD cannot detract the participants from realizing MIP and MJP because all strategies are working in the same direction. The reverse is the case in the divergent version of the matrix (part (b) of Table 1). Then, provided that both versions of the matrix are presented to the participants, the pull of the MD strategy on the MIP and MJP strategies is found as the difference in the extent of the realization of the latter strategies supported versus counteracted by the MD strategy. Expressed as a formula: pull of MD on MIP & MJP = realization score (MD + MIP & MJP) - realization score (MIP & MJP). Our hypothetical participant's allocation decision would thus reveal a pull score of seven (ten minus three).

The same logic holds for the reverse pull of MIP & MJP on MD. It is found as the difference in the extent of realization of the MD strategy as a consequence of the MIP and MJP strategies working in the same or in the opposite direction. Expressed in a formula: pull of MIP & MJP on MD = realization score (MIP & MJP + MD) - realization score (MD). In our example, this pull score is one (ten minus nine). Comparing both pull scores, we would then conclude that the participant's allocation behavior is far more strongly affected by the MD strategy as by the MIP and MJP strategies.

Note also that the pull of MIP & MJP cannot be further decomposed, because the two strategies are confounded in both versions of the matrix. However, it is possible to separate them in other matrix types (cf. Turner, 1983, p. 352f). The analysis of pull scores in other matrix types works in exactly the same way except for one matrix type which simply measures ingroup favoritism versus outgroup favoritism (see Tajfel et al., 1971). This latter matrix type does not allow for the calculation of conventional pull scores.

Visualizing the Pull Scores of Individual Participants in the Strategy Space and Identifying the Dominant Strategies

The Reference Frame of the Pull Scores. In our hypothetical example, we obtained pull scores of seven for MD on MIP & MJP and one for MIP & MJP on MD. What is the range of possible values for these pull scores? The maximum score for each one of these pull scores is 12, as we can easily deduct from the formulas and the realization scores given in Table 1. The minimum, however, is not zero but -12, which means that precisely the opposite strategy has been realized. In the case of MD, the opposite strategy consists of maximizing the difference in payoffs in favor of the outgroup (MOP). An extreme realization of this strategy would mean choosing the leftmost column in part (b) of Table 1 and the rightmost column in part (b) of Table 1. In the case of MIP and MJP, the opposite strategy is not MOP & MJP, as one might think, but minimizing the payoffs for the ingroup and also for both groups jointly. (This is because actually the MIP & MJP strategy also realizes MOP, as is easily seen from the numbers in the matrices. Therefore, the opposite strategy means jointly minimizing all these payoffs.) An extreme realization of this minimizing strategy would mean choosing the leftmost columns in both parts (a) and (b) of Table 1.

Even though both pull scores can vary from -12 to +12, they cannot take on all these values both at the same time: If one of the pull scores takes on an extreme value (i.e., -12 or +12), the other must necessarily be zero. This is of course a consequence of the adversatory logic behind the construction of the matrices and is also easily seen from the pull score formulas. More specifically, it holds that the sum of the absolute values of both pull scores cannot exceed +12. These restrictions constitute a numerical frame of reference for the pull scores that can be empirically obtained with the Tajfel matrices.

Fairness as the Third Pull Within the Reference Frame. However, the sum of the absolute pull scores may be less extreme, as in our hypothetical example cited above, where the sum of the pull scores is eight (seven plus one). It may even be zero; this happens if a participant always chooses the middle column of the matrix. This is not a rare event; in many cases, it is even the modal choice of the participants (see, e.g., Tajfel et al., 1971). Thus, one may ask what it means and how it is accounted for in the pull score analysis. To the naked eye, the meaning of such an allocation behavior is quite obvious: We can easily interprete it as following from a fairness strategy, since in the middle of the matrix both the ingroup and outgroup member receive the same payoff. Then, within the pull score reference frame described above, we may identify a third pull score representing the impact of a fairness (F) strategy as the residual pull score that remains after the two other pull scores have been determined, that is, the difference between the maximal possible sum of (absolute) pull scores (i.e., +12) and the empirically obtained sum of the (absolute) pull scores for MD vs. MIP & MJP and MIP & MJP vs. MD. An extreme realization of F would mean choosing the middle column of both matrix versions (parts (a) and (b) of Table 1), resulting in an F pull score of 12. Note that the F pull score follows the same logic as the other two pull scores insofar as the same compensatory rule holds: If one of the (absolute) pull scores reaches the maximum, the others must necessarily be zero. It differs from the others in that it cannot take on negative values.

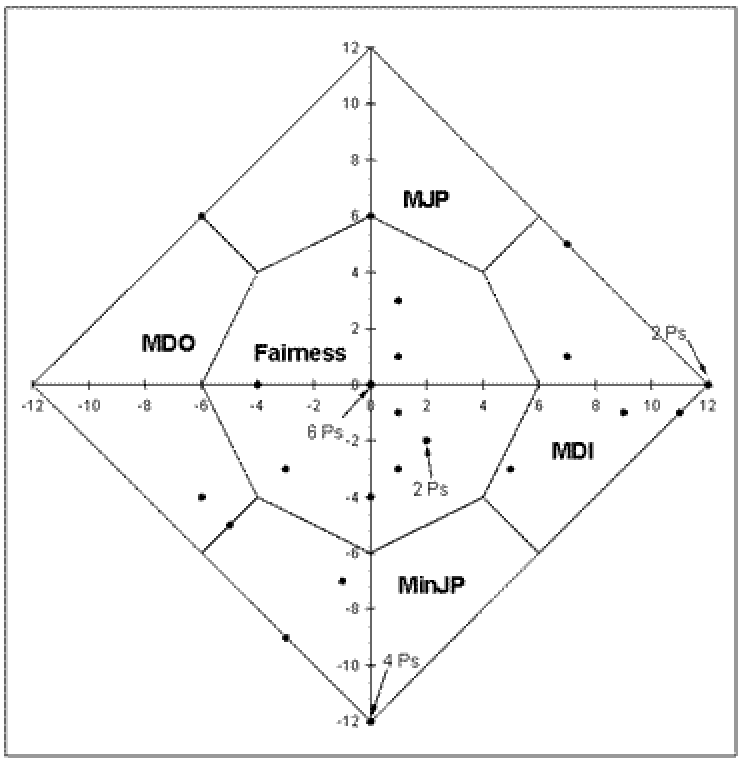
While there is some support in the literature for the interpretation of a consistent preference of the middle of the matrix as fairness (e.g., Turner, 1983; see Table 1 on p. 353), it seems appropriate to make this point more clearly and explicitly, given the important role this third pull plays in the calculation of the dominant strategies. For instance, one might counterargue that the middle of the matrix does not reflect fairness but a compromise between two opposing tendencies, in this case MD on one side and MIP & MJP on the other. While this may be true for the divergent version of the matrix (see above), it would not hold for the convergent version where both of these (combinations of) strategies are optimally realized on one and the same extreme side of the matrix. In this case, we would expect a person following both tendencies to check this extreme column. In terms of pull scores, then, such an equally strong pursuit of both MD and MIP & MJP would result in scores of 6 each, which together would exhaust the "total pull amount" of the matrix, so that nothing would remain for the fairness pull. Hence, one cannot mistake a compromise between MD and MIP & MJP for a fairness strategy, since the latter would mean a consistent preference for the middle of the matrix in the divergent as well as the convergent versions.

Also, one might argue that this allocation behavior might simply reflect a response tendency towards the middle of the matrix and would therefore be confounded with a true fairness tendency. While this is true in principle, (1) the same confound would exist between the traditional pull scores and a tendency towards the extremes of the matrix, and (2) there are also empirical data, which I will report later in this article, that show that the impact of a possible tendency towards the middle of the matrix is not strong. In any case, we can detect and also corrected for it. More important, however, is that random choices of columns also lead to apparently fair allocation behavior; I will deal with this difficulty later, too.

The Strategy Space. As the above considerations have shown, the pull scores that were intended to measure the impact of three strategies, MD, MIP, and MJP, actually have the potential to measure five distinct strategies, (1) MDI (maximum differentiation in favor of the ingroup), (2) its counterpart MDO, (3) MJP (maximum joint payoff; since this strategy is confounded with both MIP and MOP, the latter designations are redundant), (4) its counterpart MinJP, and (5) F (fairness).

We can visualize the location of these strategies within a matrix-type-specific strategy space, which is the visual analogue of the reference frame defined by the pull scores. Figure 1 shows this strategy space for the matrix type discussed here. The two pull scores associated with this matrix type constitute a coordinate system within which individual participants' allocation decisions can be displayed (the example data displayed in Figure 1 are from a standard minimal group experiment which I will describe in more detail shortly). Corresponding to the restrictions of the pull score reference frame discussed above, the coordinate system is not open but closed. That is, the circumscribed diamond-shaped area encloses all possible combinations of the two pull scores. The displayed data give a vivid visual impression of the variability and heterogeneity of the participants' allocation behavior, thus providing a richness of the data which is not reflected in the mean pull scores that are normally reported. The example shown here is a not an untypical result of a minimal group experiment: Many participants are located at or around the origin of the coordinate system, indicating a fairness strategy, whereas a sizeable minority is found at the extreme right, indicating a MDI strategy.

Figure 1: Strategy Space for the Matrix Type MD vs. MIP & MJP



Note: The x axis represents the pull score MD on MIP & MJP, and the y axis represents the pull score MIP & MJP on MD. The points represent individual participants. The data are drawn from an empirical minimal group experiment (see below). Because this experiment employed abbreviated matrices with seven columns instead of thirteen, I multiplied the original pull scores by a constant factor for comparability with the traditional scaling. The different areas within the strategy space indicate regions of dominance of the respective strategies. The strategy names differ from the usual designations as a consequence of the theoretical analysis (see text): MDI

(MDO) = Maximum differentiation in favor of the ingroup (outgroup), MJP (MinJP) = Maximizing (minimizing) the joint payoff of both groups. Ps = Participants.

Dominant Strategies

Within the strategy space, the dominant distribution strategy of an individual is the one with the largest (absolute) pull score. This is not to say that it is the only strategy the individual employs. For instance, a participant may in general allocate the payoffs fairly but exhibit a small bias in favor of the ingroup. In this case, fairness would be the dominant strategy and ingroup favoritism the second important strategy.

The areas in the strategy space within the bold lines include all possible combinations of pull scores for which the associated strategy is dominant according to the criterion given above. Data points on the boundaries between two strategy dominance areas indicate that the respective strategies are equally dominant or, seen another way, that neither of them is dominant.

The analysis of dominant strategies is not linked, however, to the visual display of the strategy space. Even though the latter is certainly useful in order to get a "feeling" for the data primarily in initial stages of the data analysis (similar to Tukey's, 1977, exploratory data analysis), for most purposes it will be too detailed and too space-consuming to be actually reported, so that a more focused quantitative analysis is desirable. This is afforded by a simple count of individuals displaying different dominant strategies, neglecting the location of these individuals within the strategy dominance area (with one exception: If an individual is located at the boundary between two or, in the extreme case, three dominance areas, s/he contributes half or a third to the count of the respective strategies). Table 2 gives the results displayed in Figure 1 in this simplified form.

Table 2: Numbers of Individuals in an Empirical Minimal Group Experiment Exhibiting Different Dominant Strategies on the MD vs. MIP & MJP Matrix Type (Same Data as in Figure 1)

Dominant strategy	MDI	MDO	MJP	MinJP	F
Number of individuals	7	2	1	6.5	15.5

These data are far less complex than the corresponding visual display but richer than the mean pull scores, the usual form in which the results are presented. For comparison, the mean pull score of MD vs. MIP & MJP calculated from these data is 0.67, and the pull score of MIP & MJP vs. MD is -1.11. Statistical tests against the null hypothesis that the respective average pull score is zero yield *t* values (*df* = 31) of 1.60 and -2.55 and corresponding probabilities (two-tailed) of .12 and .02. I will later take up the issue of statistical tests for the frequencies of dominant strategies. Before going into these details, however, it is certainly necessary to know whether such an enterprise would make sense from the start. That is, we need to know whether the five possible dominant distribution strategies are valid enough to justify their subsequent measurement and analysis.

Validation of the Dominant Strategies Through Self-Reported Strategies

Given that their reward allocations on the matrices are deliberate and intentional choices of the participants, one way to validate the objectively identified dominant distribution strategies is to compare them to the self-reported distribution strategies of the participants. I did this in a standard minimal group experiment within the context of a larger study using the minimal group paradigm (a description of the study and its results is available from the present author on request). Parts of the results of this standard experiment already appeared in Figure 1 and Table 2.

METHOD

Participants

Thirty-two students from the University of Leipzig (no psychology students) took part in the study and were paid five euros. They participated individually or in small groups.

Procedure and Design

The participants received instructions stating that they were to participate in a series of three unrelated experiments. The first task was an ostensible "color preference test," which served as a rationale for categorizing the participants into two minimal groups. During a subsequent, unrelated filler task (a 15-minute autobiographical memory task), the experimenter entered the data from each participant's color preference test sheet into a computer notebook and professed some calculations. Upon handing out the instructions for the third experiment, he explained that two groups were needed for this experiment and that for convenience these groups would be formed on the basis of the results of the color preference task, which he had analyzed in the meantime. Typically, he told the participants, people are either color-sensitive or contrast-sensitive. Accordingly, the group membership of each participant was given in handwriting in an appropriate slot of the instructions: "You belong to the … (color-sensitive / contrast-sensitive) … group." Of course, in agreement with the standard method in minimal group experiments (cf. Tajfel et al., 1971), the assignment of participants to these groups was random rather than based on their actual responses in the "test."

The third task was the resource allocation task. It consisted of 27 Tajfel matrices altogether (see below), each printed on a separate page in a small booklet. In agreement with the usual proceeding, the instructions maintained that the participants had to check one of the columns, specifying the payoffs (in points) for two persons, and that it was impossible to directly reward themselves. However, they learned that the three participants receiving the highest number of points from the other participants would win a price of 10 euros. Although merely thought as an incentive for the allocation task, this had some interesting consequences to be mentioned shortly.

Matrices

The first three matrices in each booklet were for practice and were not analyzed. The remaining 24 matrices resulted from eight different versions of three basic matrix types each (see appendix for example matrices). These basic matrix types were (1) a MDI vs. MIP & MJP matrix as already described, (2) a simple INFAV vs. OUTFAV matrix with ascending points in one row, descending points in the other, fairness in the middle, and MJP held constant (see Tajfel et al., 1971), and (3) a slightly altered version of a F vs. MDI and MIP matrix (see also Tajfel et al., 1971) which added MJP to the fairness side, resulting in a F & MJP vs. MDI & MIP matrix, thus contrasting two cooperative strategies with two group-serving strategies. However, since MJP is not a very important strategy in the minimal group paradigm (e.g., Turner, 1983), this alteration does not constitute a major departure from the conventional proceeding. The eight different versions of each matrix type resulted from four different numerical versions, each of which was in turn presented once in an original and once in a mirror-image version (left and right converted; the participants' choices on these mirror-image versions were averaged before entering into the calculation of the pull scores). As usual, each matrix type appeared in four different (inter)group comparison conditions, which resulted from the four possible combinations of group membership of the persons in the upper and lower rows of the matrix. The assignment of the four numerical versions of a given matrix type to these four conditions was counterbalanced across participants.

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Assessment of the Subjective Strategies

After having finished the matrices, the participants answered a short post-experimental questionnaire concerning their perception of the experiment and their distribution strategies. The latter were judged primarily from the answers to the first post-experimental item "Try to describe the rule or strategy you used for distributing the points to the persons" and the third item "How did the information about the group membership of the persons influence your behavior in the experiment?" (items translated into English). Additionally, answers to other items (concerning the purpose of the experiment and reasons for possible ingroup favoritism or fairness) helped to supplement the information from the main items if necessary.

Three independent raters (including myself) content-analyzed all this strategy-relevant information provided by the participants and ended up with a classification as one of several strategies, following a majority rule (that is, at least two raters had to agree upon the classification). By this criterion, we agreed on 29 of the distribution strategies of the 32 participants (91 % of the cases). We had identified candidate strategies in advance from the literature and on the basis of a preliminary study. I illustrate them here by prototypical comments of single participants in the study. A first strategy was INFAV which stands for ingroup favoritism in general and which was coded if the statements of the participants did not allow to differentiate between MDI and MIP (e.g., "I favored my own group"). Other codable strategies were MDI (e.g., " ... highest difference in points between the groups in favor of my own group"), MIP (e.g., "I tried to give as much points as possible to my own group"), MJP (e.g., "sum of both point amounts of all pairs - checked largest sum"), MinJP (e.g., "the persons should get as few points as possible"), and F (e.g., "I tried to distribute the points as fairly as possible"). Finally, there were two strategies that were unexpected from the literature but not so uncommon in the participants' self-reports. Some participants reported a random strategy, which meant that they chose the matrix columns randomly, intuitively, or at will (e.g., "I distributed the points at random"). Other participants reported to have distributed the points according to their preference for certain number combinations (e.g., "I chose those numbers that 'fit with each other' ... 4/7 are optimal together ... 18/21 fit also, but not 6/14; a feeling that I have ..."), which I will call a numbers strategy. In the qualitative analysis, the raters tried to identify one dominant strategy for each individual. This was possible for most of the participants except for a few who seem to have employed a mixture of two dominant strategies (then, provided that both strategies were coded by at least two raters, I counted each strategy half in the total analysis).

All instructions and materials employed in the experiment are available on request from the author.

RESULTS AND DISCUSSION

How do these subjective dominant strategies compare with their objective counterparts as identified via the dominant strategy analysis? Table 3 shows the relevant data. Let us turn first to the "conventional" subjective strategies (i.e., the ones that correspond to strategies mentioned in the literature or can be derived from these) in the upper part of the table. Twenty-two participants were classified as exhibiting such dominant strategies. Of these cases, 19 (86 %) corresponded to their objectively identified counterparts (if we count the combination of MDI objective and INFAV subjective as a fit). Most of the remaining inconsistencies between subjective and objective dominant strategies relate to the (subjective) INFAV strategy, which may reflect the somewhat omnibus character of this classification, as mentioned above. More important, however, are the impressive subjective corroborations of the objective MinJP and F strategies. That is, the MinJP strategy, which is not featured prominently in the literature (even though we can derive it from its well-known opposite, MJP), and the F strategy, which is not even considered in the conventional pull score analysis of the MD vs. MIP & MJP matrices but only introduced in the analysis of dominant strategies, are both validated through the participants' self-reports [1].

Table 3: Numbers of Participants Exhibiting Various Objective vs. Subjective Dominant Strategies in a Standard Minimal Group Experiment

Subjective Strategies [a]	Objective Strategies [b]	Sum

	MDI	MDO	MJP	MinJP	F	
Conventional						
INFAV	**4**	-	0.5	0.5	1.5	6.5
MDI	**1**	-	-	-	-	1
OUTFAV	-	**-**	-	-	-	-
MJP	-	-	**-**	-	-	-
MinJP	-	-	-	**4**	-	4
F	-	-	-	0.5	**10**	10.5
Sum Conventional						22
Unconventional						
Random	-	1.5	0.5	-	-	2
Numbers	2	-	-	1	2	5
Not classified	-	0.5	-	0.5	2	3
Sum Unconventional + Not Classified						10
Total Sum	7	2	1	6.5	15.5	32

Note: I have replaced zeroes within cells by dashes to make the table easier to read. Bold numbers indicate coincidence of objective and subjective strategies. Half numbers are due to two strategies being - objectively or subjectively - equally dominant.
[a] Identified via qualitative analysis of participants' self-reports by three independent raters, using a majority rule (i.e., at least two raters must agree).
[b] Identified on the basis of pull scores on the MDI vs. MIP & MJP matrices (see text).

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Consider now the "unconventional" strategies in the lower part of Table 3. Seven of the 32 participants (22 %) exhibited such strategies. As one might perhaps expect, these do not seem to correspond to any particular objective strategy. What is more important is the fact that these strategies exist at all. The impression that comes from the comments of these participants is that they encountered the minimal group experiment, and in particular the matrix distribution task, as largely meaningless and did not know how to react to this situation; thus, they opted for a strategy that best reflected this lack of meaning because it was guided itself by no "rational" principle. Finally, for three participants no dominant subjective strategy could be identified; in two cases, this was because the participants obviously had changed their strategy during the experiment.

Looking at the whole picture, it seems that, if participants report conventional subjective strategies, the objectively dominant strategies correspond quite well to these. However, the substantial number of unconventional strategies underlying the objectively dominant strategies clearly lowers the validity of the latter. Fortunately, this problem can be alleviated if the consistency of the dominant strategies across matrix types is taken into account.

Consistency as an Important Feature of Dominant Strategies

If a given strategy is truly meant to be dominant, one should expect to find it operating on each of the different matrix types (given that the design of the matrix type allows it to operate at all). Thus, consistency across matrix types may help to better identify globally dominant strategies, as opposed to what we might call locally dominant strategies on single matrix types. The latter may suffer from imperfect reliability, because conceivably, if an individual pursues no consistent strategy or a mix of strategies, one or the other strategy may turn out to be dominant on this matrix and for this person just by chance.

Now, in order to assess the global consistency of strategies across matrix types, we must first identify locally dominant strategies on various matrix types. As a rule, we can identify such dominant strategies, using the same procedure as before, for any matrix type for which pull scores can be calculated. (We can also visually display them in the same way, but I will not show this here.) Consider two often-used matrix types, MIP & MD vs. MJP and MIP & MD vs. F. Without going into the details (the derivation follows the same logic as with respect to the MD vs. MIP & MJP matrix type), we can identify the following possible dominant strategies on the MIP & MD vs. MJP matrix type: (1) INFAV (MD and MIP confounded), (2) OUTFAV (its opposite), (3) MJP, (4) MinJP, and (5) - via the third, "hidden" pull score - F. The strategies identifiable from the MIP & MD vs. F matrix type are (1) F (respectively, MinDiff), (2) MaxDiff (its opposite, which means maximizing the difference in payoffs for any two persons but irrespective of their group membership; cf. Bornstein et al., 1983), (3) INFAV as well as (4) OUTFAV (see above), and (5) from the third, "hidden" pull score, a tendency towards the middle of the matrix (which we might consider as a control score for the F strategies in the former matrix types, which were also derived from a pull towards the middle of the matrix; however, the psychological meaning of the middle is different, since it represents the point of fairness in the former matrix types but not in the latter).

We can also identify locally dominant strategies from the most simple matrix type, INFAV vs. OUTFAV, for which normally no pull scores are calculated. This is a matrix with ascending payoffs in one row and descending payoffs in the other, with fairness in the middle and MJP held constant across all columns. On this matrix, INFAV (OUTFAV) has a maximal score if the extreme column with the highest (lowest) payoff for the ingroup member and the lowest (highest) payoff for the outgroup member is chosen. The score of F is derived, just as in the analysis of the dominant strategies on the MD vs. MIP & MJP matrix type, as the difference between the maximal possible score and the score of either INFAV or OUTFAV, and we then identify the strategy with the highest score as dominant.

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Given these possibilities to identify locally dominant strategies on other matrix types as well, we can now go on to assess the consistency of dominant strategies across different matrix types, taking the data from the minimal group experiment described above. Remember that, in addition to the MD vs. MIP & MJP matrix type, two other matrix types had been employed in this experiment, a simple INFAV vs. OUTFAV matrix as discussed just before, and a minor variation of the MIP & MD vs. F matrix type which added MJP to the "F" side in order to contrast two ingroup-favoring strategies with two non-favoring strategies.

To assess the global consistency of a given dominant strategy across these three matrix types, I adopted the following rule: The strategy had to be dominant (or partially dominant, in cases where more than one strategy was dominant) in each matrix type where it was allowed to operate. Thereby, the fact that some strategies are confounded with others in single matrix types is no problem in the analysis, since these can be unequivocally separated in the consistency analysis (see Table 4).

Table 4: Overview of Identification of Consistent Dominant Strategies from Dominant Strategies in Single Matrix Types Used in the Experiment

Resulting Consistent Strategy	INFAV vs. OUTFAV Matrix Type	MDI vs. MIP & MJP Matrix Type	F & MJP vs. MDI & MIP Matrix Type
MDI	INFAV (= MDI & MIP)	MDI	MDI & MIP
MIP	INFAV (= MDI & MIP)	MIP & MJP (& MOP)	MDI & MIP
MDO	OUTFAV (= -INFAV)	MDO (= -MDI)	MDO & MOP (= -[MDI & MIP])
MOP	OUTFAV (= -INFAV)	MIP & MJP (& MOP)	MDO & MOP (= -[MDI & MIP])
MJP	--- (held constant) ---	MIP & MJP (& MOP)	F & MJP
MinJP	--- (held constant) ---	MinJP (= -[MIP & MJP & MOP])	MinJP (= -[F & MJP])
F	F (& Middle)	F (& Middle)	F & MJP
Middle	F (& Middle)	F (& Middle)	Middle

For example, the MIP strategy would be consistently dominant if INFAV (MDI & MIP) was dominant in the INFAV vs. OUTFAV matrix, MIP & MJP was dominant in the MDI vs. MIP & MJP matrix type, and MDI & MIP was dominant in the F & MJP vs. MDI & MIP matrix type (cf. Turner, 1983, p. 353, for a similar logic). We can unequivocally identify other strategies in the same way. Also, this logic allows us to separate a fairness strategy from a mere tendency towards the middle of the matrices (since fairness is not always in the middle in different matrix types). In the following, I compare the globally consistent strategies thus derived with the subjective strategies of the participants.

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According to the criterion stated above, 20 of the 32 participants exhibited consistent strategies, and in each case one single strategy turned out to be dominant. Compared to the foregoing analysis on the basis of only the MDI vs. MIP & MJP matrix type, where sometimes two strategies were equally dominant (cf. Table 3), this is a much clearer picture. But is it also a true picture? The decline in numbers of identified strategies seems to testify, at first sight, to the invalidity, rather than the validity, of the dominant strategies, since it means that some strategies previously identified on single matrix types in fact are not consistently dominant across matrices. However, this impression is readily overturned if we take the relation to the subjective strategies into account. It turns out that those dominant strategies found to be globally consistent are precisely the ones which are psychologically valid in the sense that they are corroborated by the self-reports of the participants. Table 5 shows this relation.

Table 5: Numbers of Participants Exhibiting Various Consistent Objective vs. Subjective Dominant Strategies in an Empirical Minimal Group Experiment (Total N = 32)

	Consistent Objective Strategies [b]								Sum Consistent	Not Consistent
Subjective Strategies [a]	MDI	MIP	MDO	MOP	MJP	MinJP	F	Middle		
Conventional										
INFAV	**4**	**1**	-	-	-	-	1	-	6	0.5
MDI	**1**	-	-	-	-	-	-	-	1	-
OUTFAV	-	-	-	-	-	-	-	-	-	-
MJP	-	-	-	-	**-**	-	-	-	-	-
MinJP	-	-	-	-	-	**-**	-	-	-	4
F	-	-	-	-	-	-	**10**	-	10	0.5
Sum Conventional									17	5
Unconventional										
Random	-	-	-	-	-	-	-	-	-	2
Numbers	-	-	-	-	-	-	1	1	2	3
Not Classified	-	-	-	-	-	-	-	1	1	2
Sum Unconventional + Not Classified									3	7

Total Sum	5	1	-	-	-	-	12	2	20	12

Note: I have replaced zeroes within cells by dashes to make the table easier to read. Bold numbers indicate coincidence of objective and subjective strategies. Half numbers are due to two strategies being - objectively or subjectively - equally dominant.
[a] Identified via qualitative analysis of participants' self-reports by three independent raters, using a majority rule (i.e., at least two raters must agree).
[b] Identified on the basis of pull scores on all matrices employed in the experiment (see text).

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There are two aspects of this good objective-subjective fit of the globally consistent dominant strategies: First, these strategies predominantly reflect meaningful intergroup behavior, as revealed by the subjectively reported conventional strategies. Conversely, inconsistent strategies corresponded either with unconventional random or numbers strategies or with not classifiable subjective strategies. Given that we are not really interested in the latter types of strategies for most purposes, we might say that the consistent strategies have a far better signal-to-noise ratio (17 cases reflected meaningful intergroup behavior and three did not) than the inconsistent strategies (five and seven, respectively). The signal-to-noise ratio for consistent strategies is even a conservative measure, because two cases of unconventional or not classifiable strategies are associated with a response tendency towards the middle of the matrices. These cases are easily detected in the consistency analysis and can therefore be filtered out if one is only interested in meaningful intergroup behavior (raising the signal-to-noise ratio to seventeen to one).

Second, most of the conventional strategy classifications were correct (16 out of 17, or 94%; I count the correspondence of MDI objective and INFAV subjective as a fit). Combining these two aspects: If a dominant strategy was consistent across matrices, the chances were higher that it accurately reflected a meaningful underlying social-psychological motivation and not some irrational moves of the participants out of their uncertainty, boredom, or reactance to the experimental situation (cf. Table 3 to see that the risk of such misidentifications of objective strategies is higher if we consider only one matrix type).

STATISTICAL ANALYSIS OF DOMINANT STRATEGIES

For many purposes, it is desirable not merely to be able to identify globally dominant strategies but also to perform statistical tests with respect to various research questions. Often, it will be of interest whether a particular strategy was pursued more often than another strategy (e.g., "was F more frequent than the INFAV strategies?," "did the participants discriminate more often in favor of the ingroup than in favor of the outgroup?," and so on). We can assess this with a simple binomial test. For example, Table 5 shows that there were six participants who showed (objective and globally consistent) ingroup favoritism (five times in terms of MDI and one time MIP) but none who showed outgroup favoritism. The binomial test tells us that such a result (which corresponds, statistically, to six heads or six tails in six tosses of a fair coin) is to be expected by chance alone with a probability of $p = .02$ (two-tailed; the corresponding probability for the five MIP strategies alone would be $p = .03$). Interestingly, this result, although based on only six participants, is statistically more convincing than the corresponding pull score analysis which is based on the whole sample (there, the *p* level was .12, two-tailed; see above). Thus, although generalization from this single example may be somewhat optimistic, the statistical analysis of the dominant strategies might be more powerful because it allows us to ask more focused questions (e.g., "among those participants who discriminate, are there more individuals who discriminate in favor of the ingroup?") and to ignore, for that matter, the rest of the participants who engage in other strategies and who create a large amount of "noise" for the conventional pull score analysis.

GENERAL DISCUSSION

My starting point for developing the dominant strategy analysis was the observation that the mean strategy pull scores reported as the results of many minimal group studies do not do justice to the variability and heterogeneity of the participants' distribution behavior. Possibly, this is because no method existed hitherto that would allow an analysis of individual, consistently pursued strategies. In the present work, I have suggested a method to identify such strategies. This method builds on the conventional pull score analysis but extends it in several ways. First, I use the reference frame of the conventional pull scores to identify the pull score of a third strategy within it, which represents, depending on the matrix type, fairness or a response tendency towards the middle of the matrix. One can also visually display the pull score reference frame as a strategy space, identify regions within it that correspond to specific strategies, and locate the participants individually within this space. Second, the dominant strategies of individual participants are identified - initially restricted to a given matrix type - as the strategies with the individually highest pull scores within the reference frame of the matrix. Third, we can assess these locally dominant strategies for their consistency across matrix types, yielding information about (a) whether an individual exhibits any globally consistent strategy at all and (b) the particular strategy pursued across the experiment (and the latter at a more fine-grained level than is possible within single matrix types, which often confound two strategies by matrix design).

In an empirical study, the globally consistent dominant strategies turned out to be valid predictors of the participants' self-reported strategies. Furthermore, on the basis of the consistency analysis, I could separate participants showing meaningful intergroup behavior from others who responded to the minimal group situation in an apparently irrational way, that is, by choosing matrix columns containing favorite numbers or by random responding. Thus, although the consistent dominant strategies are identified on the basis of pull scores, they seem to reflect additional qualities of the data that are not reflected in the pull scores.

What are the benefits of this dominant strategy analysis, compared to the conventional analysis of minimal group data in terms of strategy pull scores? The foremost advantage over the pull score analysis is that it yields information about interindividual differences. For instance, we know now that there were only six individuals who consistently pursued an INFAV strategy in the example experiment analysed here, twelve who consistently pursued a fairness strategy, and so on. Moreover, we see that most participants consistently pursued just one strategy and not a mixture between different strategies. We could not see this from the mean pull scores in this experiment. A second advantage is more an aside of the method that arises from the comparison with the participants' self-reported strategies - an aside, however, that we should not underestimate. These comparisons initially pointed to the fact that a certain proportion of the objectively identified strategies are pseudo-strategies in that what appears to be INFAV, F, and so on, is in fact produced by individuals following "irrational" strategies like randomly responding or choosing matrix columns containing favorite numbers. However, such false alarms are considerably reduced if we consider only those dominant strategies that are globally consistent across matrices. Thus, the analyses of globally dominant strategies serves also to enhance the quality of the data. Finally, it may also enhance the power of statistical tests for specific research questions.

Compared to the benefits, the costs of analyzing the dominant strategies are quite low, because they are calculated from the conventional pull scores, and the few addititional calculations required are simple. Thus, for anyone familiar with the pull score analysis, the dominant strategy analysis is easy to perform. This also offers the possibility to re-analyze existing data sets at essentially no cost. To this end, an EXCEL spreadsheet can be obtained from the author which greatly facilitates all calculations. In fact, all one has to do is insert a set of pull scores and get the resulting globally consistent dominant strategies (as well as the locally dominant strategies for each single matrix type). The spreadsheet is applicable to studies involving the three matrix types most commonly used in minimal group studies (i.e., MDI & MIP vs. MJP, MDI vs. MIP & MJP, and F vs. MDI & MIP). Also, the results of such analyses can be reported in a straightforward and economic fashion (cf. Table 2).

Given the importance of the participants' subjective strategies in the interpretation of the objective strategies (see Tables 3 and 5), it might be desirable to report some data concerning these as well. Unless the correspondence with the objective strategies is perfect (which will probably never be the case), they constitute important background information with respect to the interpretation of the objective strategies and also concerning the minimal group experiment as a whole. If, say, half of the participants would employ unconventional strategies like those mentioned before, this might indicate that the experimental situation was not social-psychologically "real" enough in order to provide convincing evidence for substantial intergroup effects, and that any results from such an experiment should be treated with caution. Of course, the analysis of the subjective strategies in its present form (i.e., via a qualitative analysis by independent raters of the participants' answers to open-ended questions) is very elaborate and time-consuming. However, given that most of the relevant subjective strategies have already been identified, one can considerably simplify their measurement by presenting them as multiple choice alternatives, perhaps with an additional option to describe any other employed strategy. Such a procedure would make possible a routine assessment of the participants' subjective strategies without any substantial costs.

In conclusion, the analysis of the dominant strategies (objective or subjective) of individuals in minimal group experiments tells us more about what is going on in such experiments. This can give us more confidence in our data and the conclusions we draw from these. Beyond these immediate effects, the focus on dominant strategies may also have further-reaching consequences in that it points to different kinds of research questions: Why do different individuals pursue different strategies? What determines which strategy a given individual chooses? Why are INFAV strategies pursued by only some of the participants? Does that mean that theoretical explanations for ingroup favoritism like social identity theory (Tajfel & Turner, 1986) are limited to certain people (and who would these people be)? To be sure, I do not think that such questions would pose serious problems to existing theories of intergroup behavior. However, they present challenges which may ultimate lead to further theoretical improvements.

Finally, a word may be said on the relation of the present approach to two other methods of identifying intergroup strategies, proposed by Bornstein et al. (1983) and Brewer and Silver (1978) as alternatives to the calculation of strategy pull scores from Tajfel matrices. The Bornstein et al. method consists of newly constructed, so-called multiple alternative matrices which provide choices between seven alternative strategies systematically derived from a theoretical framework. The Brewer and Silver method extracts four different integroup strategies from two subsequent choices between different two-alternative matrices. Both approaches are clever and interesting, but not without problems of their own. Arguably, some of their measures designed to isolate single strategies are in fact confounded with other strategies (see Turner's, 1983, critique of the Bornstein et al. procedure; with respect to the Brewer & Silver procedure it may be noted that, as is evident from the matrices shown on p. 395, MJP is confounded with OUTFAV, for instance). While a common feature of the present approach and these older approaches is the focus on individual dominant strategies of participants, the present analysis is different, since it builds on pull scores calculated from Tajfel matrices. Hence, because the latter have remained a standard tool in conducting minimal group experiments over the past thirty years, the potential range of applicability of the present type of analysis is considerably larger.

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APPENDIX

Example Matrix for the Matrix Type MDI vs. MIP & MJP

Matrix Nr. **19** für Versuchsperson Nr. (1) aus Gruppe (F)

Vp Nr. 14 Gruppe **K**	14	16	18	20	22	24	26
Vp Nr. 30 Gruppe **F**	6	11	16	21	26	31	36

Example Matrix for the Matrix Type INFAV vs. OUTFAV

Matrix Nr. **7** für Versuchsperson Nr. (16) aus Gruppe (K)

Vp Nr. 14 Gruppe **K**	1	3	5	7	9	11	13
Vp Nr. 26 Gruppe **F**	14	12	10	8	6	4	2

Example Matrix for the Matrix Type F & MJP vs. MDI & MIP

Matrix Nr. **14** für Versuchsperson Nr. (19) aus Gruppe (F)

Vp Nr. 17 Gruppe **F**	26	25	24	23	22	21	20
Vp Nr. 14 Gruppe **K**	3	6	9	12	15	18	21

Note: All example matrices are depicted in the original German version, as appearing in the individual matrix booklets of different participants. The participant number (e.g., 1) and group membership (e.g., F) on top of each matrix, shown here in parentheses, were originally left blank and filled in by the participants themselves, in order to enhance the credibility of the procedure and the impact of the group categorization. F and K are the initials of the German group names (F = farbsensitiv = color sensitive, K = kontrastsensitiv = contrast sensitive). Unlike the standard matrix shown in Table 1, the matrices used in the present study were abbreviated, that is, they consisted of seven instead of thirteen columns (for reasons unrelated to the present article). However, they followed exactly the same construction principles as their standard counterparts.

ENDNOTE

1. A word must be said with respect to the MinJP strategy and why it is not normally found in minimal group experiments. It has to do with the monetary incentive: The participants' stated reason for adopting this strategy was to maximize their personal chances of winning a prize, which was conditional on having received the highest amounts of points from the other participants. Thus, giving the other participants as few points as possible increases one's own chances to be the one who receives the most points (provided that the others do not adopt such a strategy, too). In essence, this is an egoistic strategy and, moreover, not an intergroup strategy at all but an interpersonal strategy (cf. Rabbie, Schot and Visser, 1989). Interestingly, this strategy did not turn out to be consistent across matrix types (cf. Table 5). This is because, in the matrix type F and MJP vs. MDI and MIP, this strategy led to apparently fair distribution behavior. This makes sense from an egoistic standpoint, because minimal differentiation between other participants minimizes the chances that any participant will receive large numbers of points.

AUTHOR'S NOTE

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