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Article *in* Journal of Personality and Social Psychology · May 2000

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Biased Information Search in Group Decision Making

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Research has shown that people prefer supporting to conflicting information when making decisions. Whether this biased information search also occurs in group decision making was examined in three experiments. Experiment 1 indicated that groups as well as individuals prefer supporting information and that the strength of this bias depends on the distribution of the group members' initial decision preferences. The more group members had chosen the same alternative prior to the group discussion (group homogeneity), the more strongly the group preferred information supporting that alternative. Experiment 2 replicated these results with managers. Experiment 3 showed that the differences between homogeneous and heterogeneous groups reflect group-level processes. Higher commitment and confidence in homogeneous groups mediated this effect. Functional and dysfunctional aspects of biased information seeking in group decision making are discussed.

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Searching for and dealing with new information plays a central role in nonroutine decision making (Bass, 1983; Janis & Mann, 1977). As shown by a multitude of studies, such information-seeking processes often are not balanced: people prefer information that supports their favored or chosen decision alternative compared to information that opposes it (Frey, 1986; Janis & Mann, 1977). At the individual level, such biased information-search processes have been studied extensively within the framework of dissonance theory (Festinger, 1957). As these studies have shown, the preference for supporting (consonant) compared to conflicting (dissonant) information occurs if people have decided voluntarily and with a certain degree of commitment for a particular alternative (for an overview see Frey, 1986). We will refer to this preference for supporting information as *confirmation bias.*[1]

Recent studies have demonstrated that this confirmation bias is not restricted to the phase after a decision has been made; it can also occur in the predecision phase if the decision maker prefers one alternative and has developed a certain commitment to that alternative (Schulz-Hardt, 1997). This converges with similar results from other fields of research showing that a distorted evaluation of the decision alternatives and a distorted evaluation of the given information (in the direction of the preferred conclusion or alternative) occur even before an actual decision is made (Boiney, Kennedy, & Nye, 1997; Russo, Medvec, & Meloy, 1996). Therefore, it can be concluded that individuals carry out biased information seeking while making decisions, and that this happens from the moment they commit themselves to a particular alternative.

Group Decision Making and Information Seeking

Nowadays, most decisions with far-reaching implications (e.g., in politics and business) are made by groups rather than by individuals. Therefore, the question of whether and to what extent such biased information-seeking processes occur within groups is of high practical as well as theoretical relevance. Unfortunately, this question has largely escaped attention. Levine and Russo (1995) investigated how the anticipation of a group discussion, in which the participants expected to be part of a minority or majority (faction size was also varied), influences information search. They found an overall preference for supporting compared to conflicting information, and this preference was most pronounced when the

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The research reported in this article was made possible by grants from the German Science Foundation (DFG, project title "Information Seeking and Information Processing in Individual and Group Decision Making," Project No. Fr. 472/12-1). We gratefully acknowledge the help of Kristiane Fago and Güler Kici, who were responsible for realizing Experiment 3.

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[1] In this context the term *confirmation bias* has a slightly different meaning than in the context of hypothesis testing, where it is also often used (e.g., Snyder & White, 1981). In the latter, *confirmatory hypothesis testing* or *confirmation bias* respectively mean looking for evidence which would confirm a preselected hypothesis, without knowing whether one will find this evidence. In the research on decision making we are referring to, confirmation bias means requesting information which will support a preselected alternative; thus, the decision-maker using this strategy knows that he will get the confirmation sought.

Journal of Personality and Social Psychology, 2000, Vol. 78, No. 4, 655–669
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participants expected to be the only minority member during the group discussion. Somewhat different results were obtained by Zdaniuk and Levine (1996) investigating information processing (thought listing) instead of information seeking: the more social support participants anticipated in a forthcoming group discussion, the more strongly their information processing was biased towards supportive arguments. But to our knowledge no studies have yet investigated whether groups show a confirmation bias when given the opportunity to search for new information that either supports or opposes the group's favored alternative.

The lack of concern for this research perspective is even more striking given that many authors stress the negative consequences of biased information seeking in high-ranking bodies: potential warning signals may be overlooked, and erroneous decisions with serious consequences may be unwittingly made (e.g., Janis, 1982; Nemeth & Rogers, 1996). However, people often seem to rely on the conventional wisdom that groups will do a better job than individuals in making decisions, because of their greater cumulative knowledge, their potential to deal with more information than individuals, and the ability of the group members to point out errors in one another's information processing (e.g., Huber, 1980).

At least three areas of research exist which raise doubts about the belief that groups perform a more balanced information search than individuals. First, groups have been shown to accentuate dominant tendencies among their members, and this is particularly true for certain biases in decision making (Tindale, 1993). If we consider the preference for supporting information a dominant bias, as has been documented by prior research (Frey, 1986), we should expect groups to accentuate this tendency.

Second, studies on information sampling and information pooling during group discussions (e.g., Stasser & Titus, 1985; Stewart & Stasser, 1998) have consistently revealed that groups mainly discuss and make use of information that was available to all group members before the start of the discussion ("shared information"); thus, they partly fail to gather and discuss information that was originally accessible to only one or a few members ("unshared information"). For certain distributions of the original information among the group members (so-called "hidden profiles"), the reliance on commonly shared information leads to the selection of an inferior alternative.

Although most explanations for this phenomenon point to the fact that shared information seems more valid and has a better chance of being remembered during group discussions than unshared information (cf. Larson, Christensen, Franz, & Abbott, 1998), Stasser and Titus (1985, p. 1470) also suggest that information conforming to the group's preferred alternative is more likely to enter the discussion than information opposing this alternative. Given that under conditions of a hidden profile shared information supports the alternative which is preferred by most group members, the results of the studies on biased information pooling could, at least partially, reflect a tendency for groups to prefer supportive to conflicting information.

The third research area that allows some predictions about biased information seeking in groups is the groupthink literature. According to Janis (1982), groupthink is a dysfunctional pattern of thought and interaction during group decision making, which is characterized by an overestimation of the group, closed-mindedness, and pressures towards uniformity. A selective search for information supporting the group's view is assumed to be one of the consequences of this pattern. Unfortunately, support for this hypothesis is only anecdotal; biased information seeking has never been systematically investigated in experiments or quantitative case studies on groupthink (for an overview see Esser, 1998).

Additionally, groupthink only occurs under limited conditions. Janis (1982) assumed that high cohesiveness of the group, together with structural faults (insulation, directive leadership, lack of methodical procedures, homogeneity of members' social background and ideology) and a provocative situational context (high stress and low group members' self-esteem), lead to groupthink. Among these antecedents, the current state of research emphasizes the role of the structural faults (Esser, 1998). Therefore, although the groupthink literature does not allow the prediction that groups per se will perform a biased search for information, it at least makes plausible the hypothesis that groups in which a controversial debate fails to occur or is suppressed can fall prey to a self-confirming information-search strategy.

According to the latter point, the distribution of individual preferences in the group should exert a strong influence on the occurrence of a confirmation bias in group decision making, because if all members favor the same alternative, a controversial discussion is unlikely to take place. On the other hand, groups with majority and minority factions of comparable strength should be more likely to engage in a controversial debate and, according to Janis (1982), perform a more balanced information search. Interestingly, the other two research areas mentioned above lead to the same prediction. The group polarization literature, which provides good examples for the accentuation of dominant individual tendencies in groups, has shown that individual attitudes and opinions are polarized in homogeneous groups (i.e., groups in which all members hold similar attitudes), while a depolarization often occurs in heterogeneous groups (Vinokur & Burnstein, 1978). Thus, it may be concluded that the accentuation of individual confirmation biases in the group should depend on whether all members prefer the same alternative individually or whether different factions exist—in the latter case, the individual confirmation biases point in different directions, which should lead to a less biased group information search.

Finally, this prediction also can be derived from the biased information-pooling literature, given that biased information pooling not only reflects a retrieval advantage of shared information but may also stem, at least partly, from a tendency to predominantly discuss information that supports the alternative that is favored by most or all group members. As Brodbeck, Kerschreiter, Mojzisch, Frey, and Schmidt (2000) have shown, the greater the diversity of individual preferences present in the group, the more the reliance on shared information is reduced. Thus, the distribution of individual preferences seems to be of particular relevance for biases in group information seeking.

Therefore, Experiment 1 compares the confirmation bias of groups in which the members' individual preferences are either homogeneous or heterogeneous with the confirmation bias of individuals. Experiment 2 uses experts instead of laypersons as participants and thereby provides evidence about the external validity of the results of the first experiment. In Experiment 3 we investigate whether the differences between homogeneous and heterogeneous groups really reflect a group-level phenomenon. Additionally, several possible mediators for these differences are tested.

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Experiment 1

In Experiment 1, we examined the extent to which biased information search appears in decision making by homogeneous and heterogeneous five-person groups compared to individuals. The participants made an individual decision concerning an investment case before entering the group discussion. Based on this decision, groups were built in which all members chose the same alternative (homogeneous groups) or in which a minority of one or two persons was present. Individuals served as a control condition.

Method

Participants and design. Two hundred students (111 females and 89 males) from the high school level (i.e., 9th–11th gymnasium grade) and college level (i.e., 12th and 13th gymnasium grade) of the Friedrich-Schiller-Gymnasium in Preetz (a town in Schleswig-Holstein in northern Germany) participated in this study. One hundred and eighty-five of these participants formed 37 five-person groups, of which 12 were homogeneous in terms of their members' individual preferences, 13 contained a minority consisting of one person, and 12 contained a two-person minority. Fifteen participants worked on the decision case individually. The investigation took place in the rooms of the above-mentioned gymnasium and was integrated into the lessons. The experiment is based on a 4 × 2 (type of decision maker: homogeneous groups, groups with one minority member, groups with two minority members, individuals; information: supportive vs. conflicting) factorial design with repeated measurement on the second factor.

Procedure. About 30 participants took part in each experimental session. At the start of the experiment, the experimenter introduced himself and his assistants and informed the participants that the present investigation was part of an interdisciplinary project which aims to set up a new curriculum for the economic sciences. This curriculum, designed for first-year university students, was intended to consist mainly of case studies which would both familiarize students with economic theory and provide a measure of their academic performance. In order to pretest such case studies, a series of investigations were being performed in gymnasiums. Additionally, the experimenter mentioned that previous research had shown the existence of a strong correlation between general intelligence and the ability to solve problem cases similar to the ones at hand. The latter remark was intended to help the experimenter to increase the participants' motivation and to raise the perceived importance of the decision to be made.

The case study (an updated version of the one used by Frey, 1981, Experiment 1), which was then distributed, describes the situation of a leading industrial company in the chemical branch which is confronted with the decision of whether or not it should invest 250 million German marks (about 125 million U.S. dollars, current 2000 exchange rate) in a particular developing country and relocate part of its production there. Both alternatives (investment or no investment) were fashioned to be equally attractive by using an identical number of supporting and opposing arguments.

All participants read the case study for themselves and first made individual decisions. Once the participants had reached their decision, they wrote a personal codeword on their sheet of paper which they were asked to use for all further questionnaires. The questionnaires were collected and sorted into groups of five on the basis of the decision taken, so that these groups could be assigned as evenly as possible to the three group conditions. Only same-sex groups were built.[2] The remaining participants were assigned to the individual control condition. Each group was seated at a separate table.

Groups and individuals were now informed that after a discussion (for the individuals: deliberation time) lasting approximately 10 min, they should make a preliminary (group) decision. A final group discussion and the final decision would take place later on. The groups wrote down their preliminary decision on a prepared form and indicated whether they had decided unanimously or by majority vote. After that the information search followed.

Groups and individuals were informed that in order to prepare the final (group) decision, additional information about the decision problem was available. This additional information consisted of 10 statements written by experts on economics. Each statement was said to be about one page in length and was summarized by a main thesis (one sentence) from which it was obvious whether the corresponding article favored or opposed an investment. These main theses were written on a sheet of paper handed out to the participants. Five of these articles were in favor of, the other five were against the investment. The groups or individuals respectively were asked to mark those articles which they wanted to read later on; they could request as many articles as they wanted. Groups were informed that each selected article would be handed out to and should be read by each member in order to make sure that all members had the same information at their disposal when the discussion about the final decision started. In fact, this instruction was given to make negotiations about the information requests necessary and thereby guarantee that the group information search is a group product.

After the request forms for the information search had been collected, the experiment was over. Participants were informed in detail about the aims of our investigation (especially why no reading of the articles and no final decision were necessary). They were thanked for their participation and then dismissed.

Results

Check for possible interfering effects and manipulation check. No significant differences were found between male and female participants or supporters and opponents of the investment respectively; similarly, participants' ages had no influence on information seeking. In only one heterogeneous group (from the two minority members condition) the minority succeeded in persuading one majority member to change preference, thereby implementing its favored alternative as the group decision. In all other cases heterogeneous and homogeneous groups made the choice that had been favored by the majority or all of its members prior to the group discussion.

To check the experimental manipulation, the number of groups reaching a unanimous decision was compared across group conditions. While all homogeneous groups made unanimous decisions, unanimity was reached only in three groups from the one minority member condition and in two groups from the two minority members condition. The corresponding chi-square-test is significant, $\chi^2(2, N = 37) = 21.00$, $p < .001$. We therefore conclude that our manipulation was successful.

Information seeking. The cell means of the experimental design are shown in Table 1. The conditions did not differ with respect to the overall number of requested articles, $F(3, 48) < 1$. Instead, a significant main effect for information emerged, $F(1, 48) = 44.01$, $p < .001$, $\eta^2 = .48$, indicating a clear preference for supporting ($M = 2.56$, $SD = 1.30$), compared to conflicting articles ($M = 1.15$, $SD = 1.09$). This main effect is qualified by an ordinal interaction with the type of decision maker, $F(3,$

[2] The reason for choosing single-sex groups was that pretests had revealed that single-sex groups worked more concentratedly on the task than mixed-sex groups. However, in the meantime additional data have shown that using mixed-sex groups doesn't change the pattern of results.

Table 1
Information Search Dependent on Type of Decision Maker in Experiment 1

Decision maker	Supporting information[a]		Conflicting information[a]		Confirmation bias[b]	
	M	*SD*	*M*	*SD*	*M*	*SD*
Homogeneous groups (n = 12)	3.33	1.07	0.92	0.90	2.42	1.78
Groups with one-person minority (n = 13)	2.54	1.33	1.00	0.82	1.54	1.71
Groups with two-person minority (n = 12)	2.08	1.68	1.42	1.51	0.67	1.37
Individuals (n = 15)	2.33	0.90	1.23	1.10	1.07	1.28

[a] Supporting articles are articles that confirm the correctness of the preliminary group decision (for individuals in the control condition, this of course is the preliminary individual decision), whereas conflicting articles dispute the correctness of this decision. [b] The confirmation bias corresponds to the difference between the number of chosen supporting and the number of chosen conflicting articles.

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48) = 2.92, $p < .05$, $\eta^2 = .15$. Post hoc comparisons using the least significant difference (LSD) method indicate that this interaction is caused by a stronger confirmation bias (i.e., a higher difference value) in homogeneous groups ($M = 2.42$, $SD = 1.78$) compared to individuals ($M = 1.07$, $SD = 1.28$, $p < .03$) and groups with a two-person minority ($M = 0.67$, $SD = 1.37$, $p < .01$). Groups with a one-person minority ($M = 1.54$, $SD = 1.71$) do not differ significantly from any of the other three conditions, nor do individuals differ from groups with a two-person minority. Separate t tests against zero revealed a significant confirmation bias for homogeneous groups, $t(11) = 4.70$, $p < .001$, groups with a one-person minority, $t(12) = 3.24$, $p < .01$, and individuals, $t(14) = 3.23$, $p < .01$. For groups with a two-person minority, the effect fell short of significance, $t(11) = 1.69$, $p < .13$.

Additionally, separate simple effects analyses were conducted for the number of chosen supporting and conflicting articles. While for supporting articles a marginal effect emerged, $F(3, 48) = 2.24$, $p < .1$, $\eta^2 = .12$, no significant differences were obtained with regard to the number of chosen conflicting articles, $F(3, 48) < 1$. Post hoc tests following the LSD procedure revealed that homogeneous groups ($M = 3.33$, $SD = 1.07$) chose significantly more supporting articles than individuals ($M = 2.33$, $SD = 0.90$, $p < .05$) and groups with a two-person minority ($M = 2.08$, $SD = 1.68$, $p < .02$). Again, no significant differences between groups with a one-person minority ($M = 2.54$, $SD = 1.33$) and any of the other conditions were observed. The different confirmation bias across different types of decision maker can thus be traced back to the different number of chosen supporting articles.

Finally, we took a closer look at those five groups that started heterogeneously but nevertheless reached a unanimous group decision. The average confirmation bias of these groups amounts to $M = 1.40$ ($SD = 1.67$) and therefore is slightly higher than the average confirmation bias of those 20 groups that remained nonunanimous ($M = 1.05$, $SD = 1.61$). However, if homogeneous groups, heterogeneous groups with a unanimous decision, and heterogeneous groups with a nonunanimous decision are compared, the overall effect is marginal, $F(2, 34) = 2.53$, $p < .1$, $\eta^2 = .13$, but according to post-hoc tests using the LSD procedure heterogeneous groups with a unanimous decision do not differ significantly or marginally from either of the other two conditions (both $ps > .25$).

Discussion

The results from the individual control condition replicate findings from prior research showing that people prefer decision-supporting information compared to information conflicting with their choice (Frey, 1986). In contrast to earlier studies which demonstrated this bias after final (irreversible) decisions, the decisions made by our participants were preliminary and thus reversible. This parallels other recent findings demonstrating that even preliminary decisions may be sufficient to provoke a confirmation bias in the search for and evaluation of information (e.g., Russo, Medvec, & Meloy, 1996; Schulz-Hardt, 1997).

With regard to the central aim of this experiment, we demonstrated that the same confirmation bias occurs in group decision making. Groups in which all five members favored the same alternative or in which only a small minority of one person opposed this choice showed a significant preference for supporting information. Only for groups in which the majority and the minority were almost equal in size (three vs. two) did this bias not reach significance, although the cell means also indicated a slight preference for supporting articles.

These results support our hypothesis that group composition affects the confirmation bias. While homogeneous groups showed a particularly strong confirmation bias, which was clearly stronger than that of individuals, this bias was slightly (though not significantly) lower in groups with a one-person minority and substantially reduced in groups with a two-person minority. So although the minorities did not successfully influence the group decision (only one minority did so), they succeeded in making the groups' information search more balanced.

Comparable influences of minorities are already known from other contexts. Conversion theory (Moscovici, 1980) postulates that consistent and flexibly arguing minorities cause a productive conflict within the group that leads to an open and balanced attempt to come to terms with the contents of the discussion. According to Nemeth (1986), minorities stimulate divergent thought processes within the group, with the consequence that better and more creative solutions arise (for an overview and integration of empirical evidence for these and related approaches see Wood, Lundgren, Ouellette, Busceme, & Blackstone, 1994). If we consider the search for supportive information to be a convergent strategy and the search for conflicting information to be a

divergent strategy, it is plausible that under minority influence the information search takes a more balanced course than without this influence (cf. also Nemeth & Rogers, 1996). This is especially the case if the minority consists of two persons, because support by a second member gives the minorities additional self-confidence and thus increases their influence on the decision process (Wood et al., 1994).

What remains somewhat unclear is the role of those groups that started the group discussion as heterogeneous but reached unanimity before performing the information search. Their confirmation bias lay in between the information search pattern of homogeneous groups and that of groups remaining heterogeneous (i.e., groups which made a decision by majority vote). Due to the small number of heterogeneous groups with a unanimous decision ($n = 5$), no powerful statistical tests could be performed with regard to those groups. Therefore, the question of whether the confirmation bias in heterogeneous groups is reduced by the presence of dissenting views at the beginning of the group discussion or whether this depends on the minority maintaining its deviant view until the information search cannot be answered at this point. Experiments 2 and 3 will provide further insights.

Two other questions remain. The first is whether we really captured a group-level phenomenon or whether the groups simply aggregated individual information requests; in the latter case the lower confirmation bias in heterogeneous groups would be due to the fact that the minority members search for information in favor of the alternative that they preferred individually. This question will be addressed in Experiment 3. The second question is whether or not our results may be population specific; our participants were high school and college students and thus did not have much experience with making responsible economic decisions. Experiment 2 was conducted to determine if our findings could be replicated for groups of persons who actually have this experience.

Experiment 2

The structure of Experiment 2 is similar to Experiment 1, with the slight difference that, due to the smaller sample size available, groups of three were built, and therefore a distinction was only made between homogeneous and heterogeneous groups. No individual control condition was run. Managers in responsible positions were taken as participants.

Method

Participants and design. Fifty-seven male managers from banks and industrial companies (e.g., from the information technology branch or the retail trade) in Germany participated in this study. Most of them belonged to the middle management level. At that time all managers were attending courses (about heterogeneous themes like financing or controlling) at the Business Academy of Schleswig-Holstein in Kiel or at the Business Academy of Mecklenburg-West Pomerania in Rostock (both located in Germany). Nineteen three-person groups were formed, of which eight were homogeneous and eleven were heterogeneous with regard to their members' individual preferences. The experiment is based on a 2 × 2 (group composition: homogeneous vs. heterogeneous; information: supportive vs. conflicting) factorial design with repeated measures on the second factor.

Procedure. The course of this experiment was identical to that of Experiment 1, with the above-mentioned exception that the groups consisted of only three persons. Because of that, the group composition factor, which was again manipulated on the basis of the previous individual decisions, had only two levels in this experiment.

Results

Check for possible interfering effects and manipulation check. The chosen alternative (investment vs. no investment) had no significant influence on information seeking. All groups decided for the alternative that had been favored by the majority or all of its members prior to the group discussion. To check the experimental manipulation, unanimity of the group decisions was again used. While all homogeneous groups made unanimous decisions, this was only the case for two of the eleven heterogeneous groups. Since the expected frequencies in some cells are smaller than five, Fisher's exact test was used; with a value of $p < .01$ it becomes significant. The experimental manipulation can thus be regarded as having been successful.

Information seeking. Cell means for the information search are shown in Table 2. As in Experiment 1, the main effect for the information factor becomes significant, $F(1, 17) = 19.26$, $p < .001$, $\eta^2 = .53$. Supportive information ($M = 3.53$, $SD = 1.43$) was chosen more often than conflicting information ($M = 1.89$, $SD = 1.89$). This main effect is qualified by a significant interaction with group composition, $F(1, 17) = 6.85$, $p < .02$, $\eta^2 = .29$, due to the fact that the confirmation bias in homogeneous groups ($M = 2.88$, $SD = 1.64$) is much stronger than in heterogeneous groups ($M = 0.73$, $SD = 1.85$). Separate t tests show that the confirmation bias of homogeneous groups differs significantly from zero, $t(7) = 4.95$, $p < .01$, while the confirmation bias in heterogeneous groups does not reach significance, $t(10) = 1.31$, $p > .2$. Separate simple effects analyses reveal that the differences between homogeneous and heterogeneous groups can be traced back to the supporting articles: while homogeneous groups requested more supporting articles ($M = 4.38$, $SD = 0.52$) than heterogeneous groups ($M = 2.91$, $SD = 1.58$), $F(1, 17) = 6.32$,

Table 2
Information Search Dependent on Group Composition in Experiment 2

	Supporting information[a]		Conflicting information[a]		Confirmation bias[b]	
Group composition	*M*	*SD*	*M*	*SD*	*M*	*SD*
Homogeneous ($n = 8$)	4.38	0.52	1.50	1.60	2.88	1.64
Heterogeneous ($n = 11$)	2.91	1.58	2.18	0.87	0.73	1.85

[a] Supporting articles are articles that confirm the correctness of the preliminary group decision, whereas conflicting articles dispute the correctness of this decision. [b] The confirmation bias corresponds to the difference between the number of chosen supporting and the number of chosen conflicting articles.

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$p < .03$, $\eta^2 = .27$, no significant differences were observed for the number of conflicting articles sought (for homogeneous groups: $M = 1.50$, $SD = 1.60$; for heterogeneous groups: $M = 2.18$, $SD = 0.87$), $F(1, 17) = 1.43$, $p > .2$.

A particularly strong confirmation bias occurred in those two groups which started heterogeneously but then came to a unanimous decision ($M = 3.50$, $SD = 0.71$). In an additional analysis these groups were compared to the homogeneous groups ($M = 2.88$, $SD = 1.64$) and to those heterogeneous groups that stayed nonunanimous ($M = 0.11$, $SD = 1.36$). Post-hoc tests (LSD procedure) were conducted to further differentiate the significant overall effect, $F(2, 16) = 9.38$, $p < .01$, $\eta^2 = .54$. According to these, no significant difference occurs between heterogeneous groups with a unanimous decision and homogeneous groups ($p > .5$), whereas both differ from heterogeneous groups with a nonunanimous group decision (both $ps < .01$). Of course, because of the extremely small sample size in the heterogeneous/unanimous condition, this analysis can only be seen as exploratory.

Discussion

The results of Experiment 2 replicate those of the first experiment. Once again, a clear preference for supportive compared to conflicting information appeared in homogeneous groups, whereas no significant confirmation bias was found in heterogeneous groups. Therefore, we can state that groups of experts, namely people who are familiar with investment decisions, also show a confirmation bias while seeking information if their members' individual preferences are homogeneous. Further, it thus holds true for groups of experts that minorities counteract a confirmation bias in information seeking.

Additionally, the results of those two groups that were composed heterogeneously but nevertheless reached a unanimous decision indicate that, as predicted by Moscovici's (1980) conversion theory, in order to exert this influence the minority has to be consistent and maintain its divergent viewpoint until the information search begins. As the confirmation bias in the two heterogeneous groups that made a unanimous decision was as pronounced as that of homogeneous groups, an initial divergence of views that vanishes over the course of the group discussion does not seem to have any impact on information seeking. However, due to the extremely small sample, and as Experiment 1 had led to slightly different results—there the heterogeneous/unanimous groups lay in between the other two conditions—further interpretation will be delayed until Experiment 3 has substantiated these findings.

Even if the differences between homogeneous and heterogeneous groups documented in the first two experiments represent a stable finding and can be replicated for different samples, it still remains unclear whether we really captured a group-level phenomenon or whether we simply demonstrated individual confirmation bias in a group setting. In other words, did the groups really discuss and bargain about their information requests, or did they simply combine individual information requests and thereby perform group information search as a divisible task? Because in the latter case results similar to ours would emerge without any "real" reduction of confirmation bias taking place in heterogeneous groups (each group member performs a confirmatory search in the direction of his/her own individual decision), this question is a serious one.

Of course, the experimental instructions were given in a way that was supposed to guarantee discussion about the information search. For all groups, it had been made clear that each selected article would be handed out to and should be read by all group members. Thus, groups were expected to discuss and negotiate which articles to actually request. As the results of Experiment 1 indicate, the participants seem to have heeded our instructions, because individuals and groups did not differ with respect to the number of requested articles. If the groups had simply aggregated individual information requests, one would have expected groups to seek more articles.

However, this result alone is not sufficient to demonstrate that our results really reflect a group-level phenomenon. Therefore, Experiment 3 will provide a more direct test. Further, if we are dealing with a group-level phenomenon, what is missing so far is an explanation for the fact that heterogeneous groups search for information in a relatively balanced way, whereas homogeneous groups show a clear confirmation bias. This question of possible mediators is also addressed in Experiment 3.

Experiment 3

To test whether the differences between homogeneous and heterogeneous groups reflect influence processes within these groups or whether they are due to a combination of individual processes, an additional step was included in the experimental procedure. After making their individual decision, the participants were asked to indicate which articles they would individually request. This enabled us to combine the individual information requests to a statisticized group and compare the real groups' information search against that baseline. If we are dealing with a group-level phenomenon, systematic differences between the real groups' information requests and their statisticized group baselines should occur: homogeneous groups should be more biased than expected on the basis of their members' individual information requests (vice versa for heterogeneous groups).

Additionally, Experiment 3 deals with possible mediators for the differences between homogeneous and heterogeneous groups (given that these differences are not exclusively based on the statistical aggregation mentioned above). As a model that combines and organizes motivational and cognitive influences on information seeking and information processing, the multiple-motive heuristic-systematic model (HSM, see Chaiken, Liberman, & Eagly, 1989) was chosen as a basic framework from which potential mediators were derived.

According to the multiple-motive HSM, effortful systematic processing of information, of which information search is considered to be a good indicator (Lundgren & Prislin, 1998), takes place only to the degree that a sufficient level of confidence has not yet been reached. Additionally, preferences for different kinds of information can be induced by three different types of motivation, namely, defense motivation, accuracy motivation, and impression motivation (Chaiken et al., 1989). Each of these, as well as the level of confidence, may be responsible for the differences between homogeneous and heterogeneous groups.

First, past research has shown that consensus within a group increases confidence (e.g., Julian, Regula, & Hollander, 1968); thus homogeneous groups should be more confident about having found the best alternative than heterogeneous groups. According to

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the HSM, this heightened confidence should reduce their willingness to engage in effortful processing. If we assume that reading conflicting articles is more effortful than reading supporting articles (because the former cannot be easily integrated into one's prior representation of the decision problem), then a stronger confirmation bias in homogeneous groups should be the consequence. Thus, confidence about having found the best alternative was measured in Experiment 3.

Second, a stronger defense motivation in homogeneous groups could be responsible for the results. Chaiken et al. (1989) define defense motivation as any desire to form or defend a particular attitudinal position. Dissonance processes are the perhaps most well-known example for this, but generally each activity with the goal of confirming the validity of preferred positions and disconfirming the validity of nonpreferred positions constitutes a case of defense motivation. A crucial variable determining the strength of defense motivation is commitment: the more a person feels committed to a particular position, the greater the desire is to uphold this position even when confronted with conflicting opinions or evidence. Receiving social support could increase group members' commitment to the preliminary group decision in homogeneous groups, thereby inducing a defense motivation which, as shown by Lundgren and Prislin (1998), causes a pronounced confirmation bias. We thus included commitment as a dependent variable in Experiment 3.

Third, the consistent exposure to conflicting views could induce a stronger accuracy motivation among the members of heterogeneous groups. Accuracy refers to the desire to hold positions that are congruent with relevant evidence and leads to a balanced search for and evaluation of information (Lundgren & Prislin, 1998). In order to capture this mechanism, the perceived importance of making a good decision was measured in Experiment 3.

Fourth and finally, impression motivation could be responsible for the differences between homogeneous and heterogeneous groups. Generally, impression motivation is defined as the striving for socially acceptable positions. With regard to information search, impression motivation induces a preference for information that is in accordance with the position of significant social targets (Lundgren & Prislin, 1998). If this is applied to our experimental procedure, impression motivation could stem from the desire to understand and get along with the other group members during the (anticipated) further group discussion. In homogeneous groups this should induce a preference for decision-supporting information, because all persons in the group are in favor of the preliminary group decision. In heterogeneous groups a more balanced information search should result, because the minority should favor information supporting the group's decision (which is identical to the majority's position), while the majority should prefer information in favor of the nonchosen alternative (which is identical with the minority's position). As an indicator for the strength of impression motivation, sympathy (i.e., liking for the group members) was included as a dependent variable in this experiment.

Method

Participants and design. One hundred thirty-eight students (93 females and 45 males) from the high school level (i.e., 10th and 11th gymnasium grade) and college level (i.e., 12th and 13th gymnasium grade) from the Hermann-Tast-Schule and the Theodor-Storm-Schule in Husum and from the Carl-Jacob-Burkhardt-Gymnasium in Lübeck (both are cities in Schleswig-Holstein in northern Germany) participated in this study. These 138 participants formed 46 three-person groups, of which 23 were homogeneous and 23 were heterogeneous with regard to their members' individual preferences. Three groups (two homogeneous and one heterogeneous) had to be excluded from the analysis because of incomplete data for the individual measurement. The investigation took place in the rooms of the above-mentioned gymnasiums and was integrated into the lessons. The experiment is based on a 2 × 2 × 2 (group composition: homogeneous vs. heterogeneous; measurement: statisticized vs. real group; information: supporting vs. conflicting) factorial design with repeated measurement on the second and third factor. For all additional dependent variables, which were measured to find possible mediator variables, the latter two factors are irrelevant.

Procedure. The course of Experiment 3 is similar to that of Experiment 1 and 2, with four differences. First, in Experiment 3 a different case study was used, according to an agreement with the participating schools, because this case study could be integrated into the lessons more easily. Instead of the investment case from Experiments 1 and 2, a decision problem from the area of economic policy was used. The decision problem used deals with the question of whether taxes on oil in Germany should or should not be raised. Both alternatives (tax raise vs. no tax raise) were again supported by an identical number of arguments that had been constructed to be equally strong. Second, after making their individual decisions, but before entering the group discussion, the participants performed an individual information search by marking on the overview sheet those articles which they wanted to read personally. When they had marked their requests, they were told that handing out and reading the articles would be delayed until the group discussion was over.

Third, after making their preliminary group decision, the groups were asked to indicate on scales from 0 to 10 how important making a good decision was for them, how certain they were about the correctness of their decision, and how difficult they thought finding a good decision was. The latter two items were averaged to give an overall *confidence* index (the difficulty item was reversed; the correlation between these two items was $r = .57$). Fourth and finally, an additional form was handed out on which the participants had to indicate how sympathetic (i.e., likable) they judged each of the other two group members to be and to what extent they felt committed to the group decision. From the values of the three persons belonging to the same group, the average values were calculated for the analyses described below.[3]

Results

Check for possible interfering effects and manipulation check. Neither participants' gender nor age influenced the information search. However, in contrast to the other experiments, we found differences between the two decision alternatives. Whereas individuals and groups that decided for a tax raise only show a slight and nonsignificant confirmation bias (for individuals: $M = 0.35$, $SD = 1.83$, $t(64) = 1.56$, $p < .13$; for groups: $M = 0.33$, $SD = 1.11$, $t(20) = 1.38$, $p < .19$), this confirmation bias differs significantly from zero among participants voting against the tax increase (for individuals: $M = 2.19$, $SD = 1.87$, $t(63) = 9.37$, $p < .001$; for groups: $M = 2.09$, $SD = 1.66$, $t(21) = 5.91$, $p < .001$). The comparison of supporters and opponents of a tax increase becomes significant for both the individual measurement, $F(1,$

[3] Additional potential mediators, which were not derived from the HSM (e.g., task-interest and perceived competence), were also measured for exploratory analyses. None of these variables turned out to have a mediating effect. Further information about these variables and analyses can be obtained from the first author.

127) = 5.63, $p < .001$, $\eta^2 = .20$, and the group measurement, $F(1, 41) = 16.50$, $p < .001$, $\eta^2 = .29$. Since the distribution of supporters and opponents of the oil tax increase is nearly equal for the homogeneous and heterogeneous groups—among the homogeneous (heterogeneous) groups, 10 (11) groups decided for and 11 (11) groups decided against the increase—and because the pattern of results in homogeneous and heterogeneous groups is parallel for both alternatives, the analysis of the experimental design seems to be justified in spite of the effects above.[4]

Unanimity versus nonunanimity of the group decision was again used to check the experimental manipulation. While all 21 homogeneous groups made unanimous decisions, only 7 of the 22 heterogeneous groups did so. The corresponding chi-square test was significant, $\chi^2(1, N = 43) = 21.99$, $p < .001$. We therefore consider the experimental manipulation to be successful.

Group information seeking. As in the previous experiments, a significant effect for information emerged, $F(1, 41) = 29.11$, $p < .001$, $\eta^2 = .42$. Supportive information ($M = 3.40$, $SD = 1.07$) was chosen more often than conflicting information ($M = 2.16$, $SD = 1.21$). Once again, this main effect is qualified by an ordinal interaction with group composition, $F(1, 41) = 9.24$, $p < .01$, $\eta^2 = .18$. As the corresponding difference values show, the preference for supportive information is more pronounced in homogeneous groups ($M = 1.95$, $SD = 1.63$) than in heterogeneous groups ($M = 0.55$, $SD = 1.41$). While for the former the confirmation bias significantly differs from zero, $t(20) = 5.50$, $p < .001$, this effect is only marginal for heterogeneous groups, $t(21) = 1.82$, $p < .09$.

Separate simple effects analyses show that the different confirmation bias in homogeneous compared to heterogeneous groups is due to the conflicting articles: heterogeneous groups ($M = 2.68$, $SD = 1.17$) chose significantly more conflicting articles than homogeneous groups ($M = 1.62$, $SD = 1.02$), $F(1, 41) = 10.01$, $p < .01$, $\eta^2 = .20$, whereas with regard to chosen supporting articles no difference between homogeneous ($M = 3.57$, $SD = 0.98$) and heterogeneous groups ($M = 3.23$, $SD = 1.15$) was observed, $F(1, 41) = 1.11$, $p > .25$.

As in Experiments 1 and 2, those initially heterogeneous groups that nevertheless made a unanimous decision were examined more closely. The average confirmation bias of these seven groups was $M = 1.43$, $SD = 0.98$. If this is compared to the confirmation bias of homogeneous groups ($M = 1.95$, $SD = 1.63$) and heterogeneous groups with a nonunanimous decision ($M = 0.13$, $SD = 1.41$), a significant overall effect emerges, $F(2, 40) = 6.78$, $p < .01$, $\eta^2 = .25$. As post hoc tests (LSD procedure) indicate, heterogeneous groups with a unanimous decision do not differ significantly from homogeneous groups ($p > .4$), while both differ from heterogeneous groups with a nonunanimous decision ($p < .01$ and $p < .07$ for homogeneous and heterogeneous/unanimous groups respectively). Further, whereas the confirmation bias is significant for heterogeneous groups with a unanimous decision, $t(6) = 3.87$, $p < .01$, it is far from significant for heterogeneous groups with a nonunanimous decision, $t(14) = 0.37$, $p > .7$. Thus only those (homogeneously or heterogeneously composed) groups that reached a unanimous decision showed a confirmation bias.

Real versus statisticized groups. To test whether the differences between homogeneous and heterogeneous groups reflect group processes or are simply a product of an aggregation of individual biased information-seeking strategies, the information search of each group was compared with a statisticized group information search that had been calculated on the basis of the individual information requests. If group information search was carried out by aggregating the individual information requests, then each group should select all those articles that had been selected by at least one group member. Therefore the statisticized groups' information search was calculated by counting how many of the articles supporting and conflicting with the subsequent group decision were requested by at least one group member. These numbers were compared with the numbers chosen by the real groups.

Because of the logic of this analysis, all groups in which one or more group members had revised their individual decision during the group discussion had to be excluded. As a consequence of this revision, their information preferences should also have changed; their prior individual information search should thus no longer reflect their information preferences at the moment when the group carries out its information search. Therefore, the seven initially heterogeneous groups that made a unanimous decision did not enter the analysis.[5] Additionally, in two heterogeneous groups the minority was successful in persuading one member of the former majority. These two groups were also excluded. Thus the 21 homogeneous groups were compared with those 13 heterogeneous groups that had made a nonunanimous decision reflecting the initial distribution of individual preferences.

If the differences between homogeneous and heterogeneous groups were a pure aggregation phenomenon, then the only significant effects should be a main effect for information (supporting articles should be preferred to conflicting ones) and a two-way interaction between information and group composition. Combining three individuals whose individual confirming strategies point in the same direction should lead to a stronger confirmation bias in statisticized homogeneous groups compared to statisticized heterogeneous groups because in the latter groups one member's bias points in the opposite direction. The group measurement should simply reflect these differences.

On the contrary, if the differences between homogeneous and heterogeneous groups were a group-level phenomenon, then two additional effects should emerge. First, real groups should request fewer articles than statisticized groups. Second, and even more importantly, the above-mentioned effects should be qualified by a significant three-way interaction of information, group composition, and measurement. Homogeneous groups should be *more* biased than expected on the basis of their statisticized baselines, while heterogeneous groups should be *less* biased compared to that baseline. All in all, the differences between homogeneous and heterogeneous groups should be more pronounced than predicted by a statistical combination of individual information requests.

[4] Including the decision alternative as a further between-subjects factor in the experimental design or using it as a covariate does not change the results reported below.

[5] If the seven groups changing from heterogeneity to unanimity nevertheless enter the analysis as a third (quasi) experimental condition, the subsequent results reported are not qualified, because these seven groups show the same pattern of results as those groups that were homogeneous from the beginning. This also holds true for the mediation analyses.

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Table 3
Information Search in Statisticized (Individual Measurement) and Real (Group Measurement) Homogeneous and Heterogeneous Groups in Experiment 3

Group composition	Supporting information[a]		Conflicting information[a]		Confirmation bias[b]	
	M	*SD*	*M*	*SD*	*M*	*SD*
Statisticized (individual measurement)						
Homogeneous (n = 21)	4.48	0.81	3.14	1.28	1.33	1.59
Heterogeneous (n = 13)[c]	4.61	0.51	3.69	0.95	0.92	1.19
Real (group measurement)						
Homogeneous (n = 21)	3.57	0.98	1.62	1.02	1.95	1.63
Heterogeneous (n = 13)[c]	3.15	1.41	3.31	1.78	−0.15	1.21

[a] Supporting articles are articles that confirm the correctness of the preliminary group decision, whereas conflicting articles speak against the correctness of this decision. [b] The confirmation bias corresponds to the difference between the number of chosen supporting and the number of chosen conflicting articles. [c] Note that only those heterogeneous groups in which no opinion change occurred prior to the preliminary group discussion entered this analysis (see the "real vs. statisticized groups" paragraph in the *Results* section). The cell means and standard deviations are thus not identical to those reported in the "group information seeking" paragraph.

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Means and standard deviations are shown in Table 3. The results strongly support our hypothesis that the differences between homogeneous and heterogeneous groups reflect group-level processes. On the one hand, the two effects which are predicted by both hypotheses become significant, namely the main effect for information, $F(1, 32) = 18.98$, $p < .001$, $\eta^2 = .37$, and the two-way interaction of information and group composition, $F(1, 32) = 7.31$, $p < .02$, $\eta^2 = .19$. Because these results simply substantiate what we already know from the former analyses (supporting information is preferred to conflicting information, and this preference is stronger in homogeneous groups), we will leave these effects aside.

On the other hand, the two effects that are predicted exclusively by the group-level hypothesis also become significant. First, as indicated by the significant main effect of measurement, $F(1, 32) = 43.14$, $p < .001$, $\eta^2 = .57$, in the real group measurement a smaller number of articles ($M = 5.68$, $SD = 1.70$) was requested than in the statisticized group measurement ($M = 7.88$, $SD = 1.30$). Second, and most importantly, this effect is qualified by a significant three-way interaction of group composition, measurement, and information, $F(1, 32) = 13.72$, $p < .001$, $\eta^2 = .30$, indicating that the differences between homogeneous and heterogeneous groups are significantly stronger in the real group than in the statisticized group measurement.[6] An inspection of the cell means in Table 3 clarifies this effect.

As predicted by the aggregation hypothesis, statisticized homogeneous groups show a somewhat stronger confirmation bias ($M = 1.33$, $SD = 1.59$) than statisticized heterogeneous groups ($M = 0.92$, $SD = 1.19$), although this difference does not reach significance if tested separately, $F(1, 32) < 1$. So this is the difference we would expect between homogeneous and heterogeneous groups in the group measurement if nothing happened at the group level. However, real groups differ from their statisticized baselines with regard to the confirmation bias. We will label these differences *net group bias.* The confirmation bias of homogeneous real groups ($M = 1.95$, $SD = 1.63$) is stronger than the corresponding bias in their statisticized baseline, $t(20) = 2.36$, $p < .03$, which is identical to saying that a net group confirmation bias has occurred. The opposite is true for the confirmation bias in heterogeneous real groups ($M = -0.15$, $SD = 1.21$) compared to their baseline, $t(12) = -2.69$, $p < .03$. In fact, the latter groups do not show any confirmation bias, $t(12) = -0.46$, $p > .65$, although their statisticized baseline is biased, $t(12) = 2.80$, $p < .02$. In this case, a net group confirmation debiasing has occurred.

As separate simple effects analyses show, the fact that the difference in confirmation bias between homogeneous and heterogeneous groups increases from the statisticized to the real group measurement is mainly due to the conflicting articles. In both conditions the groups requested fewer articles compared to the statisticized group measurement. With regard to the reduction of supporting requests (supporting articles chosen by the real group minus supporting articles chosen by the statisticized group), homogeneous groups ($M = -0.90$, $SD = 1.00$) and heterogeneous groups ($M = -1.46$, $SD = 1.51$) do not differ significantly, $F(1, 32) = 1.69$, $p > .2$. On the other hand, the reduction of conflicting requests was much stronger in homogeneous groups ($M = -1.52$, $SD = 0.93$) than in heterogeneous groups ($M = -0.38$, $SD = 1.19$), $F(1, 32) = 9.72$, $p < .01$, $\eta^2 = .23$. In fact, no significant reduction of conflicting requests took place in heterogeneous groups, $t(12) = -1.16$, $p > .25$, while the other three difference means significantly differ from zero, $t(20) = -4.17$, $p < .001$, $t(20) = -7.52$, $p < .001$, $t(12) = -3.50$, $p < .01$ (same order as above).

Mediation analyses. The question now is how the difference between the net group bias of homogeneous and heterogeneous groups is mediated. Three of the four potential mediators derived from the multiple-motive HSM, namely confidence, defense motivation, and accuracy motivation, were analyzed according to the mediation criteria set forth by Baron and Kenny (1986). These criteria are: (a) The independent variable must influence the me-

[6] The results of the analyses do not change if, instead of treating measurement as a within-groups factor, real group measurement is first regressed on the statisticized group measurement, and then the residuals are taken as the dependent variable.

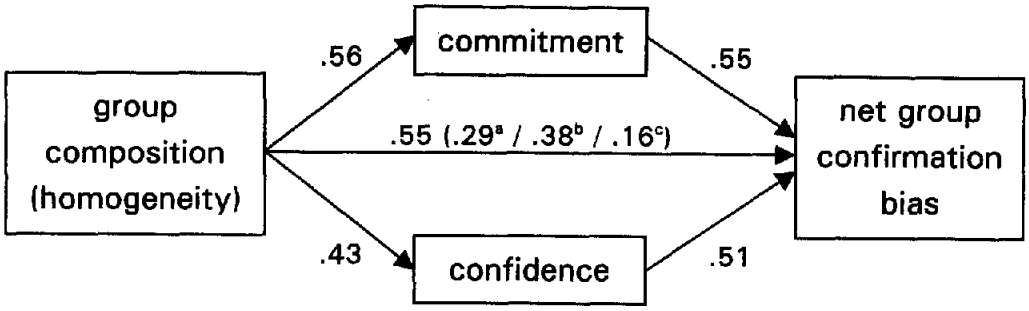

Figure 1. Path analyses illustrating the mediating effect of commitment and confidence for the influence of group composition on the net group confirmation bias in Experiment 3. Path coefficients represent beta weights. Group composition was dummy coded (0 = heterogeneous, 1 = homogeneous). [a] Beta weight for homogeneity when commitment is controlled for. [b] Beta weight for homogeneity when confidence is controlled for. [c] Beta weight for homogeneity when both commitment and confidence are controlled for.

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diator, (b) the mediator must influence the dependent variable, and (c) controlling for the influence of the mediator, the influence of the independent variable on the dependent variable must be substantially lowered.

With regard to the first condition, significant differences between homogeneous and heterogeneous groups were found for confidence, $F(1, 32) = 7.16, p < .02, \eta^2 = .18$, and commitment, $F(1, 32) = 14.43, p < .001, \eta^2 = .31$. Homogeneous groups indicated a higher level of confidence ($M = 7.62, SD = 1.63$) than heterogeneous groups ($M = 5.81, SD = 2.32$), and the members of homogeneous groups felt more strongly committed to the group decision ($M = 7.97, SD = 1.15$) than the members of heterogeneous groups ($M = 6.20, SD = 1.55$).[7] No significant differences were found for importance; the means were $M = 7.76$ ($SD = 2.55$) for homogeneous groups and $M = 7.85$ ($SD = 2.54$) for heterogeneous groups, $F(1, 32) < 1$.

Examining the second condition by calculating regression analyses in which the net group bias (i.e., the confirmation bias in the real group minus the confirmation bias in the statisticized group) is the criterion and the corresponding potential mediator is the predictor, significant effects were found for commitment, $\beta = .55$, $t(32) = 3.69, p < .001$,[8] and confidence, $\beta = .51$, $t(32) = 3.33$, $p < .01$. The positive signs of the regression weights indicate that a higher level of commitment and confidence is accompanied by a stronger net group confirmation bias. Now the last condition has to be examined, namely whether the statistical control for commitment or confidence respectively reduces the predictive power of group composition for the net group bias. Using the net group bias as the criterion and group composition as the predictor, the standardized regression weight for group composition is $\beta = .55$, $t(32) = 3.70, p < .001$. If the influence of commitment on the net group bias is controlled for, the regression weight for group composition is only marginal, $\beta = .29$, $t(32) = 1.72, p < .1$. A decrease in the regression weight also occurs if confidence instead of commitment is controlled for, although in this case the regression weight is still significant, $\beta = .38$, $t(32) = 2.35, p < .03$.

In an additional analysis both variables, which are not significantly correlated ($r = .23, p > .20$), were included. Together they accounted for 45% of the variance in the net group bias, $F(2, 31) = 12.89, p < .001$, with regression weights $\beta = .46$, $t(31) = 3.34, p < .01$ for commitment and $\beta = .41$, $t(31) = 2.97$, $p < .01$ for confidence. The interaction of commitment and confidence did not add significant predictive power, $t(30) = -1.27$, $p > .20$. If the influence of both commitment and confidence is controlled for, the regression weight for group composition in predicting the net group bias is substantially reduced to $\beta = .16$, $t(32) = 0.94, p > .35$. All in all, both commitment and confidence mediate the effect of group composition on the net group bias, although, since β has not been reduced to zero, no full mediation has been shown. These findings are illustrated in Figure 1.

To test the mediating role of impression motivation, a different approach was necessary because, contrary to a confidence-based, defense-based, or accuracy-based explanation, an explanation based on impression motivation does not assume a different motive strength in homogeneous compared to heterogeneous groups. Instead, the effects should result from the fact that those who are the targets of this impression motivation hold different positions. If this is the case, then any variable that influences the strength of

[7] The lower commitment of heterogeneous groups cannot be explained exclusively by the fact that minorities naturally indicate smaller values here ($M = 4.54$); the majorities in heterogeneous groups also show a smaller degree of commitment ($M = 7.04$) than the members of homogeneous groups ($M = 7.97$). Separate comparisons between each pair of conditions show that the average commitment in homogeneous groups significantly differs from the commitment of the minority in heterogeneous groups, $t(14.33) = 4.03, p < .001$ (due to heterogeneity of variances, the separate variance estimate was chosen) and from the average commitment of the majority in heterogeneous groups, $t(32) = 2.17, p < .04$. The commitment of the majority and that of the minority were compared using a paired samples t test; this test also revealed a significant difference, $t(12) = 3.34$, $p < .01$.

[8] It could be suspected that this effect is mainly due to the lower commitment of minority members. On the contrary, in heterogeneous groups the correlation between majority commitment and the net group bias is significant ($r = .77, p < .01$), while the correlation between minority commitment and the net group bias is not ($r = .41, p > .15$). Thus, the results of the mediation analysis for commitment do not substantially change if only the commitment of the two majority members is considered for heterogeneous groups (although in this case the reduction of the beta-weight for group composition in predicting the net group bias is less pronounced than if the commitment of all three group members enters the analysis).

impression motivation (in both conditions) should turn out to be a moderator for the differences between homogeneous and heterogeneous groups.

As one of these variables, sympathy for the other group members was measured. If impression motivation directs information search, then in homogeneous groups higher levels of sympathy should be accompanied by a stronger net group confirmation bias, because for all members decision-supporting information is identical with information in favor of the other group members' position. In heterogeneous groups, the sympathy judgments of minority and majority members should be differently related to the net group bias. The more sympathy the minority member feels for the majority members, the more this minority should prefer information in favor of the majority members' position (the group decision) and the stronger the net group confirmation bias thus should be. On the other hand, the more sympathetic the majority members judge the minority to be, the more articles in favor of the minority position should be requested, and therefore the weaker the net group confirmation bias should be.

However, the results are not in line with this expectation. As predicted, the minority's sympathy for the majority members was positively correlated with the net group bias ($r = .49$, $p < .1$). However, the majority members' sympathy for the minority was also positively (though not significantly) correlated with this bias ($r = .46$, $p < .12$). Additionally, and again contrary to the predictions made, in homogeneous groups the correlation between sympathy and the net group bias was marginally negative ($r = -0.38$, $p < .09$). A regression analysis shows that average sympathy among the group members significantly moderates the effect of group composition on the net group bias (for group composition: $\beta = 2.53$, $t(30) = 3.58$, $p < .001$; for sympathy: $\beta = -.39$, $t(30) = -1.74$, $p < .1$; for interaction of group composition and sympathy: $\beta = 1.96$, $t(30) = 2.92$, $p < .01$, but the direction of this effect is opposite to the one predicted by an impression-motive based explanation.

Discussion

The main goals of this experiment were twofold. We wanted to clarify whether the differences between homogeneous and heterogeneous groups are in fact a group-level phenomenon, and we wanted to find mediators for these differences. Both attempts were successful. As in the previous experiments, homogeneous groups were shown to have a strong confirmation bias, whereas no significant bias occurred in heterogeneous groups.[9] The comparison of the real group with the statisticized group measurement demonstrated that this difference reflects group-level processes and is not due to a simple aggregation of individual confirming strategies: the difference between the confirmation bias of homogeneous and heterogeneous groups was significantly exaggerated in the real group measurement. In relation to their (already confirmatory biased) statisticized baselines, homogeneous groups showed an even stronger preference for confirming information, whereas a confirmation debiasing took place in heterogeneous groups.

Additional analyses revealed that these differences between homogeneous and heterogeneous groups are, at least partly, mediated by three mechanisms. First, a heterogeneous distribution of individual preferences increases the likelihood that the group will be heterogeneous when making the preliminary decision (i.e., that the group will make a nonunanimous decision). It is only in this case that heterogeneous groups significantly differ from homogeneous groups. If the conflict is resolved before the preliminary decision is taken, these groups show almost the same biased information-search pattern as groups that were homogeneous from the outset.

Second, commitment and confidence both seem to be responsible for the difference between homogeneous groups and those groups that stay heterogeneous. On the one hand, the knowledge that all members prefer the same alternative heightened commitment to the group's decision, thereby inducing, as assumed by the multiple-motive HSM (Chaiken et al., 1989), a stronger defense motivation than in heterogeneous groups. On the other hand, consensus on the preferred alternative led to higher confidence about the correctness of the group's decision, as has been demonstrated in prior research (Julian, Regula, & Hollander, 1968). This higher confidence induced a stronger confirmation bias among homogeneous groups. If we assume that processing conflicting information is more effortful than processing supporting information, then these results are also in line with the multiple-motive HSM, because according to this model effortful processing should only be undertaken if the decision maker feels insufficient confidence about the issue at hand.

However, we found no evidence that accuracy motivation and impression motivation contribute to the differences between homogeneous and heterogeneous groups. The importance of making a good decision (as an indicator of accuracy motivation) was not judged to be higher among heterogeneous compared to homogeneous groups. Additionally, although sympathy for the group members moderated the effects of group composition on the net group bias, the pattern of results was practically the reverse of the one proposed by an impression-motive based explanation. While the latter proposes that the differences between homogeneous and heterogeneous groups are particularly strong if the overall level of sympathy for each other within the group is high, in fact sympathy decreased the differences between homogeneous and heterogeneous groups. If we consider sympathy (or interpersonal liking) as an indicator of group cohesiveness (see Cota, Evans, Dion, Kilik, & Longman, 1995), then this result could indicate that highly cohesive groups are less influenced

[9] A slight difference from the previous experiments was present. In both Experiment 1 and 2 the effect of group composition was due to differences in the number of chosen supporting articles, whereas in Experiment 3 this effect was caused by differences in the number of chosen conflicting articles. Although we can only speculate about the reasons for this, one plausible explanation could be that in Experiment 3 the participants had performed an individual information search prior to group discussion. Thus, the participants had read the arguments summarized in the main theses of the articles and may have mentioned some of them in the group discussion prior to the group information search. Because discussion is longer and more intense in heterogeneous compared to homogeneous groups (Brodbeck et al., 2000), heterogeneous groups would be expected to discuss arguments from the main theses more often than homogeneous groups. Discussing these arguments may have heightened interest in reading the corresponding (supporting and conflicting) articles. If this were the case, then the number of supporting articles requested by heterogeneous groups would move closer to the number requested by homogeneous groups, and at the same time the requests for conflicting articles by heterogeneous groups would exceed those made by homogeneous groups. As a consequence, the conflicting instead of the supporting articles would now be responsible for the differences between homogeneous and heterogeneous groups.

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by cues like consensus or majority/minority distribution of initial preferences and thus perform a group decision process that is less dominated by the members' individual positions (cf. also Gruenfeld, Mannix, Williams, & Neale, 1996)—with regard to the minorities, this is exactly what the groupthink hypothesis (Janis, 1982) states.[10] However, further investigations are needed to substantiate this point.

Finally, we only found evidence for partial mediation. Thus, additional variables could contribute to the differences between homogeneous and heterogeneous groups. In Experiment 3 the emphasis was on motivational mediators derived from the multiple-motive HSM (Chaiken et al., 1989). However, as Chaiken and Maheswaran (1994) have shown, nonmotivational influences such as heuristic cues can also lead to biased processing. In group decision making this could mean that information about consensus triggers a "consensus implies correctness" heuristic, and that this heuristic makes supporting information appear more credible and valid than conflicting information. This evaluation could induce a preference for supporting information even in the absence of a motivation for confirmatory information seeking. Further experiments in which the groups are asked to evaluate the articles before the information search is done would help clarify whether exclusively cognitive mechanisms also trigger differences between homogeneous and heterogeneous groups.

General Discussion

In three experiments we have consistently shown that the same confirmation bias that has been found for individuals (Frey, 1986) also occurs in group decision making: groups in which all members had chosen the same alternative individually or in which the minority was relatively small compared to the majority (the five-person groups with a one-person minority in Experiment 1) preferred pieces of information which support the favored alternative compared to those which oppose it. On the other hand, a minority of one person in a three-person group and of two persons in a five-person group weakened this tendency, but, in accordance with conversion theory (Moscovici, 1980), this happened only if the minority stayed consistent over the course of the group discussion. If we consider the results of all three experiments, then initial disagreement within the group seems to have little impact on the confirmation bias if this conflict is resolved before the information search starts.

The results of Experiment 2 underline that our findings are not confined to participants with little or no experience in making responsible economic decisions; on the contrary, groups of middle-management employees showed the same confirmation bias as laypersons when composed homogeneously and the same relatively balanced information search when composed heterogeneously. In demonstrating that homogeneous groups are more biased than predicted on the basis of each member's individual information requests, while heterogeneous groups are less biased compared to this baseline, Experiment 3 has substantiated that these results actually reflect group-level processes. Additionally, this experiment has led to the identification of two mediators for the differences between homogeneous and heterogeneous groups, namely commitment to the preliminary group decision as well as confidence of having found the best alternative. The absence of minority dissent was shown to lead to stronger commitment to the group decision and higher confidence in having already found the best alternative—both of which induce a confirmatory search for information.

Biased Information Search and Quality of Group Decision Processes

The pattern of results described above is open to two interpretations which differ particularly with regard to how the quality of the decision processes in homogeneous vs. heterogeneous groups is judged. On the one hand, one could interpret the behavior of the members of homogeneous groups as being ego-defensive (commitment path) and self-satisfied (confidence path): The group wants to justify the correctness of its preliminary decision by predominantly searching for supporting information, and because the members are already convinced that they have found the best alternative, they don't see much need to consider conflicting information. This interpretation, which largely resembles a dissonance theoretical view of biased information search (Festinger, 1957; Frey, 1986), suggests that the members of homogeneous groups are rationalizing instead of rationally trying to find the best alternative.

In this view, the homogeneous groups' information-search pattern is past-oriented (justifying a prior choice) and thus detrimental to effective decision making. Related research on the influence of homogeneous vs. heterogeneous preference structures on group processes could be seen as supporting this view. For example, prior studies have shown that groups that are homogeneous, in that their members share the same preferences, judgments, or decisions before entering the group discussion, are predisposed towards overconfidence (Sniezek, 1992), underestimate risks to a greater extent (S. Williams & Taormina, 1993), reach less accurate judgments (Sniezek & Henry, 1989), generate less emergent hypotheses during collective hypothesis testing (Crott, Giesel, & Hoffmann, 1998), discuss a decision problem less intensively (Brodbeck et al., 2000), and produce worse solutions in problem solving (Wanous & Youtz, 1986) than groups with diverse initial viewpoints. Further, Brodbeck et al. (2000) demonstrated that the reliance on commonly shared information is stronger in homogeneous than in heterogeneous groups.

On the other hand, we could also adopt a functional perspective, saying that (in terms of Nemeth, 1986) effective decision making requires a divergence phase as well as a convergence phase, and both phases require different cognitive and motivational processes. Divergence involves scrutinizing the decision problem and the available alternatives, whereas convergence involves committing oneself to a particular alternative and upholding it against opposing forces. Thus, many of the above-mentioned characteristics of homogeneous groups (e.g., the confirmation bias, overconfidence, and underestimation of risks) fulfill requirements of the convergence phase (see Beckmann & Kuhl, 1984; Gollwitzer & Kinney, 1989). From this perspective, the members of homogeneous groups do not become ego-defensive or ignorant, but rather develop a convergent cognitive and motivational orientation ("mind-set" according to Gollwitzer & Kinney, 1989) aimed at upholding a behavioral intention, because they feel confident about and committed to a particular alternative. This also represents some kind of defensive and confidence-driven behavior, but this

[10] Interestingly and in accordance with this interpretation, those nine groups in which members changed their individual decision over the course of the group discussion indicated the highest levels of overall sympathy (M = 8.77, SD = 1.69), although they did not significantly differ from homogeneous groups (M = 8.39, SD = 1.26) or heterogeneous groups without an opinion change (M = 7.38, SD = 2.01).

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behavior is future-oriented (maintaining an intention) instead of past-oriented (self-justification). In support of this view, homogeneous groups have been found to be more effective in implementing decisions than heterogeneous groups (White, Dittrich, & Lang, 1980).

Even if we adopt this functional perspective, we could still suspect homogeneous groups of being premature in their movement from divergence to convergence. This raises the question of how groups (or individuals) can detect the optimal point for this movement. The results of our experiments, as well as those of the Zdaniuk and Levine (1996) study mentioned earlier (according to which the confirmation bias in information processing is positively correlated with the degree of social support anticipated in a forthcoming discussion), indicate that people use social consensus information to determine this point. In the absence of unambiguous cues that indicate the superiority of a particular alternative, inferring the correctness of a group decision from social consensus may be a rational guideline.

However, this guideline is only accurate to the degree that the group composition itself is "unbiased" (i.e., that the group composition somehow represents the opinion distribution in the population). The latter is often not the case because group formation is guided by the principle of similarity among potential group members (Hogg & Turner, 1985) or because socialization in an organization leads to management teams in which members hold similar opinions (Schein, 1968). So from the functional perspective taken in this interpretation, a problem of homogeneous groups could be that they don't recognize this *similarity bias* in the group composition and thus overestimate the validity of their social consensus information. Or, in the case of initially heterogeneous groups moving towards unanimity, they might neglect the impact of conformity pressures and thus interpret the minority's opinion change as an instance of error detection (the minority has realized its initial mistake). This reasoning follows an idea brought up by Fiedler, Brinkmann, Betsch, and Wild (in press), saying that people are quite accurate in drawing inferences from their information samples, but they often lack the metacognitive knowledge of how the sample itself may be biased.

Finally, regardless of whether the confirmation bias in homogeneous groups stems from ego-defensiveness and ignorance or from a functionally different orientation toward the decision problem—an important question remains: Should the occurrence of this bias, particularly in an early stage of the decision process, be prevented? The answer to this question depends largely on the underlying model of "optimal" decision making ('t Hart, 1998). If one assumes that carefully detecting advantages and disadvantages of the alternatives at hand is the best way to make decisions (e.g., Janis, 1982; Nemeth & Rogers, 1996), then of course homogeneous groups show premature convergence and a defective information search. However, other authors (e.g., Brunsson, 1982) claim that preventing indecisiveness by immediately bolstering confidence and focussing on the opportunities of the preferred alternative often far outweigh the risk of overlooking serious disadvantages of the preferred alternative. In this regard, the homogeneous groups' information search is superior to that of heterogeneous groups.

Each model may be appropriate in specific contexts. If there is sufficient time for an intensive elaboration of all relevant issues, if a prolonged decision process does not lead to serious opportunity costs (e.g., a competitor gaining a "first move" advantage), and if risks with strong negative consequences are at stake, then the first model may be more suitable and a confirmation bias should thus be prevented. The second model with its emphasis on ability to act may be more appropriate in competitive, unstable environments (Judge & Miller, 1991). In addition, in many contexts the consequences of a particular alternative may not be fixed at the time the decision is made, but instead may depend largely on the degree of confidence held by the decision maker and communicated to the outside world—political decision making provides good examples of this (see Bovens & 't Hart, 1996). In these cases, biases that lead to a confirmation of the preferred alternative and thereby raise the decision maker's conviction of doing the right thing should be particularly useful (see also Dosi & Lovallo, 1997). Because of these different issues, simply recommending a heterogeneous group composition in order to raise the quality of group decision processes would be misleading.[11]

Implications for Further Research

These considerations have two important implications for further research. First, if a confirmation bias is advantageous in some contexts and problematic in others, then the question is whether groups are sensitive to these different contexts. In other words, do they show a confirmation bias only if it is advantageous for them, or do they fall prey to this bias even when its costs far outweigh its benefits? Settling this question requires developing a taxonomy of situations in which a confirmation bias pays or does not pay and then experimentally inducing these situations (if possible) in group decision making. Manipulating variables like cohesiveness, homogeneity, leadership, or group size across these different types of situations could reveal under which conditions groups adapt their information-search pattern to situational requirements and under which conditions they fail to do so.

Finally, if situations can be identified in which a confirmation bias is dysfunctional and groups nevertheless show this bias, then the question is how a balanced search for information can be stimulated. The results of the experiments reported here point out that providing a heterogeneous group composition is useful for this, but the debiasing effect of a consistent minority need not appear under all conditions. For example, Stewart and Stasser (1998) have shown that minority influence in group information pooling is strong when the group task is defined as problem solving, but this influence disappears if the group believes itself to be working on a judgmental task. In our experiments the instructions given by the experimenter facilitated representing the decision case as a problem-solving task. It is an open question whether the same minority influence on the confirmation bias can be observed if this (or another) decision case is introduced as a judgmental task.

Further, forming groups with heterogeneous preferences among its members may not always be possible. In situations where conflict is desired, while at the same time the members' individual opinions may be strongly congruent, the use of dialectical tech-

[11] Of course these considerations are only one aspect belonging to the broader question of functional vs. dysfunctional consequences of conflict vs. concurrence-seeking in group decision making. However, this integration lies outside the scope of this article. Excellent overviews about this larger context are given by De Dreu and Van de Vliert (1997) as well as K. Y. Williams and O'Reilly (1998).

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niques like "devil's advocacy" or "dialectical inquiry" (Mason & Mitroff, 1981) is often recommended (e.g., Janis, 1982). These techniques institutionalize a controversial debate within the group, independent of the actual homogeneity or heterogeneity of opinions. However, whether such techniques counteract biased information seeking in the same way as the existence of a "real" minority has yet not been empirically demonstrated. Finding answers to those questions may lead to a better understanding of the functional and dysfunctional aspects of group information seeking and group decision making and may provide a basis for effective interventions, where necessary.

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Received March 5, 1999
Revision received October 4, 1999
Accepted November 4, 1999 ■

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