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How to achieve synergy in group decision making: Lessons to be learned from the hidden profile paradigm

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Based on over 25 years of research on hidden profiles and information sharing in groups, and particularly our own work in this area, we outline a general model of how groups can achieve better decisions in a hidden profile situation than their individual members would have been capable of (i.e., synergy). At its core the model defines *intensity* and *bias* as the two key parameters that have to be optimised with regard to both the *discussion of information* and the *processing of information* in order to ensure synergy in group decision making. We review the empirical literature on information sharing and group decision making in the hidden profile paradigm (with a particular focus on our own studies) to illustrate how group decision quality can be enhanced by increasing intensity and decreasing bias in the discussion and processing of information. Finally we also outline why we think that the lessons learned from research using the hidden profile paradigm can be generalised to group decision-making research in general, and how these lessons can stimulate studies in other fields of group decision-making and group performance research.

Keywords: Group performance; Hidden profile; Information pooling; Process gain; Synergy; Biased sampling.

Important decisions with far-reaching consequences are often made by groups rather than individuals. For example, the managerial board of an organisation is responsible for strategic decisions affecting the whole organisation, high-ranking personnel (e.g., in a university) are hired by selection committees, and police investigations in particularly important

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criminal cases are subjected to special commissions. One of the reasons for the popularity of groups when it comes to making decisions is the belief that using groups will pay off with regard to decision quality. Taking up the spirit of Aristotle's famous words that "the whole is more than the sum of its parts", groups are often expected to achieve "synergy"; that is, to yield a surplus in decision quality that individual decision makers would not be capable of (e.g., McGrath, 1984). However, the reality of group decision making often falls short of these expectations. The aim of this paper is to shed some light on why this may be the case and, hence, how this deficit might be overcome.

NECESSARY PRECONDITIONS FOR SYNERGY IN GROUP DECISION MAKING

The above-mentioned question of whether and under what conditions working in groups yields a group-specific surplus in performance is at the heart of social psychological group performance research (for an overview, see Schulz-Hardt & Brodbeck, 2012). The basic aim of this research is to determine whether interaction and social interdependence in a group facilitate or hinder performance, and to specify the particular cognitive, motivational, and coordination processes that are responsible for this facilitative or inhibiting effect of group interaction. To this end, group performance is compared with a statistical baseline that indicates what performance would be expected in the absence of any functional or dysfunctional group processes. Often this baseline is determined by either introducing nominal groups (i.e., groups where no interaction takes place and all members generate their contributions to the group product individually) or by measuring the real group members' individual contributions (e.g., their individual judgements or their individual proposals) prior to the real group interaction. If group performance exceeds this baseline, then a group-specific performance surplus has been identified (and vice versa for group performance below the baseline).

Over time, such group-specific performance surplus has been discussed and investigated under different labels such as, for example, "assembly bonus effect" (Collins & Guetzkow, 1964) or "process gain" (Hackman & Morris, 1975). Recently Larson (2010) extended and integrated these earlier approaches into a general framework of *synergy* in groups. Whereas so-called *weak synergy* is said to occur if group performance exceeds the average performance in a nominal group, *strong synergy* requires the group to perform better than even the best individual member of a nominal group does.[1]

[1]So far, "process gains" is the term most frequently used in the literature to denote a performance surplus that is due to group-specific processes. However, the use of this term

With regard to group decision making, this approach implies that groups realise synergy if (and only if) they make decisions that have a higher quality than either the average or the best of their group members' individual decisions prior to group interaction—the former would constitute weak synergy, whereas the latter would be a case of strong synergy. This is an important implication, because it indicates that in many decision-making situations groups will not have the potential to realise such synergy. For example, let us assume that the group has to decide among several alternatives, and each alternative is characterised by certain advantages and disadvantages. For the sake of simplicity, let us further assume that all advantages and disadvantages have equal strength. (We know that this is often not the case, but all of the following arguments could also be made with advantages and disadvantages of different strength—only with the reasoning becoming more complex.)

Obviously then, the best alternative is the one with the most advantages and the least disadvantages, the second best alternative scores second best on advantages and disadvantages, and so on. Typically, not all group members know about all advantages and disadvantages of the various alternatives individually. Whereas some pieces of information will be known to all members of the group (such pieces of information are called *shared information*), other pieces of information (so-called *unshared information*) will be unique knowledge of a single group member. There is, of course, also information that is known to some but not all members of a group—once again, for the sake of simplicity, we will leave this *partially shared information* aside. However, it would not change the nature of our arguments if this type of information were taken into account.

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involves some problems. Similar to Larson's concept of synergy, the conceptual idea is to determine a plausible baseline of performance that occurs in the absence of (functional or dysfunctional) group processes and then measure whether group performance exceeds this baseline (which would indicate process gains) or falls below this baseline (showing process losses). The baseline used to determine process losses and process gains is the so-called *group potential*, a concept developed by Steiner (1972) in his influential book on productivity in groups. The problem is that Steiner did not foresee the possibility of process gains; his analysis only dealt with process losses. Consequently his idea of group potential was that it should denote the *maximum* productivity possible when taking task demands and group member resources into account. This implies that researchers who are (also) interested in the detection of process gains either have to work with an artificially enhanced baseline, which makes the detection of such process gains rather unlikely, or have to apply a more pragmatic group potential, which (at least partially) departs from the original definition and meaning of the concept. In turn, what might be called "process loss" in one analysis might be a "process gain" in another one. To avoid such problems we decided to apply the Larson (2010) synergy concept throughout this paper.

It is the unshared information that makes group decision making an attractive choice for someone who wants to increase decision quality: Because different members bring different knowledge to the table, having a group discuss and decide a decision problem should lead to a broader knowledge base for the decision, and this should increase decision quality (e.g., Hollenbeck et al., 1995).

Now, unless systematic asymmetries are present that make the advantages (or disadvantages) of certain alternatives particularly unlikely to be shared among members, it is very likely that each group member has individual information prior to discussion that is more or less representative of the overall information. In other words, not everybody knows everything, but most group members should have individual information that makes the best alternative look good (or even superior to all others) right from the beginning, and the worst alternative should also appear to be relatively weak from the start onwards. Such a situation is called a *manifest profile*, because the rank-order of alternatives is evident from the beginning (Lavery, Franz, Winquist, & Larson, 1999). The important point is: Whenever information is distributed in this way, groups can hardly realise synergy in group decision making. Discussing the issue in the group might enlarge each member's individual knowledge base, but this will not have substantial impact on the final decision: Because it was evident from the beginning which alternative was best (and, hence, at least the large majority of group members should have preferred it from the beginning), having a group discuss and decide the issue hardly has any potential to increase decision quality (for a related point, see Hastie & Kameda, 2005).

This reasoning directly implies that, if we expect group decision making to lead to synergy, and if we want to check whether this really is the case (or how such synergy can be facilitated), we have to look at situations where the correct or best choice is *not* evident from the beginning. Such situations are called *hidden profiles* (Stasser, 1988). In the next section we will briefly describe these situations, and we will highlight the, more or less, disappointing performance of groups when dealing with hidden profiles. We will then outline a general model categorising the processes that are necessary for solving hidden profiles and, hence, for the realisation of synergy (and even strong synergy!) in group decision making. In addition we will map the empirical hidden profile literature onto these categories, with a particular focus on our own studies during the last 10 years. In the final section we will draw implications from the model and will discuss whether and to what extent these considerations can be generalised to other types of group tasks like, for example, problem solving.

HIDDEN PROFILES: THE (OFTEN MISSED) OPPORTUNITY TO REALISE SYNERGY IN GROUP DECISION MAKING

The hidden profile paradigm

As previously outlined, systematic synergy in group decision making is only possible if the correct choice (i.e., the best alternative) cannot be detected by group members based on the individual information that they privately have prior to discussing the issue in the group. This is exactly the case in the *hidden profile paradigm*, introduced by Stasser and Titus (1985). In a hidden profile one of the decision alternatives is superior to the others when the full information set (i.e., the total of the information available at the group level) is taken into account. However, this superiority only becomes evident when the group members' unshared (i.e., uniquely held) information is pooled and integrated into a revised appraisal of the alternatives. In the case of a hidden profile, much of the information supporting the best alternative (i.e., advantages of this alternative and disadvantages of other alternatives) is unshared, whereas the shared information either supports one or more suboptimal alternatives or no alternative at all. Hence hidden profiles can be solved only if group members exchange and integrate their unshared pieces of information and thereby are able to detect the decisional implication of the full information set.

An example of such a hidden profile information distribution is given in Table 1; we have used this material in some of our own studies on group decision making (e.g., Schulz-Hardt, Brodbeck, Mojzisch, Kerschreiter, & Frey, 2006). The participants play the role of personnel managers in an airline company that is looking to hire a new pilot for long-distance flights. The material is constructed for use in three-person groups (although it can easily be modified for other group sizes). When taking all information into account, it is clear that Candidate C is vastly superior to Candidates A, B, and D: Whereas Candidate C has seven advantages and only three disadvantages, Candidates A, B, and D each have only four advantages, but six disadvantages. As we have mentioned above, we operate with the simplifying assumption that the different advantages and disadvantages are (almost) equal in strength. Therefore in empirical hidden profile studies extensive pretests are necessary to make sure that this assumption is met and that participants do, on average, perceive similarity in importance and reliability between the different pieces of information.

However, whereas all of the advantages of Candidates A, B, and D as well as all the disadvantages of Candidate C are shared, all disadvantages of Candidates A, B, and D as well as most advantages of Candidate C are unshared (and each group member has the same amount of unshared information). As a consequence each group member individually knows the

four advantages of A, B, and D, but only two of the disadvantages of each of these candidates. In contrast, each group member is aware of all three disadvantages of Candidate C prior to discussion, but knows only three of this candidate's seven advantages (the one shared advantage plus two of the six unshared advantages). Hence for each group member Candidate C should appear as the weakest candidate prior to discussion (and, hence, group members should favour A, B, or D), although this candidate is, in fact, the best choice based on all information. As outlined earlier, the correct choice cannot be identified prior to discussion. And, as we can see from Table 1, this information distribution bears a large potential for synergy, because by choosing Candidate C the groups can make a vastly superior decision compared to what should be the outcome without information exchange in the group (namely a decision for Candidate A, B, or D).

The failure of groups to solve hidden profiles

Since Stasser and Titus' seminal study published in 1985, many empirical investigations of group decision making in hidden profiles situations have been conducted. So far, these empirical investigations have been —with one very recent exception (Stasser, Abele, & Vaughan Parsons, 2012)— exclusively laboratory experiments. This focus does not neglect the importance of hidden profiles in the field, but for practical reasons investigating hidden profiles in field settings is almost impossible: Detecting them would require that the researcher knows the whole set of decision-relevant cognitions of all group members prior to the first group meeting, and it is hard to see how that could be realised in the field. In contrast, in a laboratory setting the researcher has perfect control over the decision-relevant information available to group members and, thus, has the ability to induce any information distribution of interest.

The typical procedure in these laboratory experiments is to invite participants to the lab and provide each of them with general instructions as well as individual information about a decision case. Usually university students serve as participants in these experiments, but there are also studies with a practitioner sample such as, for example, medical teams working on medical disease diagnosis (e.g., Larson, Christensen, Franz, & Abbott, 1998). There are typically two (Winquist & Larson, 1998), three (e.g., Stasser & Titus, 1985), or four (e.g., Schulz-Hardt et al., 2006) decision alternatives. After participants have studied their individual materials and have evaluated the different decision alternatives based on this information, the information materials are collected by the experimenter, which means that participants discuss the decision case from memory. Although this might, at first glance, appear to be an artificial constraint, a closer look reveals that this procedure is not that ecologically invalid, because group members hardly ever have a

written excerpt of all their decision-relevant knowledge with them when discussing and deciding an issue in a group. Even in cases where written (or electronically stored) materials about the decision case exist (e.g., the candidate information files in an appointment committee), and hence group members can flip through these materials during discussion, it is often the private (unshared) knowledge of the group members that has a particular impact on the final decision (e.g., "I know that XY just bought a house in Aston, so it is highly unlikely that he will move over to London").

Prior to group discussion, participants usually receive further instructions. In particular participants are made aware of the fact that the individual information sets that they have received are not identical: Whereas some pieces of information are shared among them, other parts of the individual information differ among members. Furthermore, it is typically emphasised that the decision case features a superior alternative that can be found on the basis of all the information that is available to group members as a whole, and that the participants' task is to identify this superior alternative. At least in our own experiments, it is also standard to have a financial incentive for groups to detect this superior alternative.

Hence, unlike in decision-making groups in practice that often lack the above-mentioned features, preconditions for the realisation of synergy in group decision making are almost optimal in these experiments: There is no deception involved, full transparency about the requirements of the situation is given, and there are no side-bets that might motivate group members to favour suboptimal alternatives (e.g., they have no external incentive for "pushing through" their own candidate in a personnel selection task)—the only external incentives given are in favour of cooperatively trying to find the best alternative.

In spite of these almost ideal conditions, more than 25 years of research on hidden profiles have shown that groups actually fare pretty badly at detecting and solving hidden profiles. For example, in the seminal Stasser and Titus (1985) study, 83% of the groups chose the best alternative in the manifest profile condition[2], but only 18% did so in the hidden profile conditions. Similarly, in the Schulz-Hardt et al. (2006) study that used the case material from our example in Table 1, all groups in the manifest profile condition made the correct decision, whereas only 35% of the groups in the hidden profile conditions picked the best alternative; although, as we have seen, this alternative is vastly superior to any of its competitors. These two studies are no outliers: As systematic reviews of the hidden profile literature (e.g., Brodbeck, Kerschreiter, Mojzisch, & Schulz-Hardt, 2007) as well as a

[2]In this condition participants were given the full information set right from the beginning. However, we still label such a condition "manifest profile", because the defining feature (initial information set is representative of the overall information set) is necessarily true in such a case.

TABLE 1
An example of a hidden profile task

Candidate A	Candidate B
– **can anticipate dangerous situations**	– **keeps calm in a crisis**
– **is able to see complex connections**	– **known to be 100% reliable**
– **has excellent spatial vision**	– **good at assessing weather conditions**
– **has very good leadership qualities**	– **has excellent computer skills**
– is sometimes not good at taking criticism	– can be grumpy
– can be unorganised	– can be uncooperative
– is regarded as a show-off	– has a relatively weak memory for numbers
– is regarded as being not open to new ideas	– makes nasty remarks about his colleagues
– is unfriendly	– is regarded as pretentious
– eats unhealthily	– sometimes adopts the wrong tone when communicating
Candidate C	**Candidate D**
– can make correct decisions quickly	– **responds to unexpected events adequately**
– handles stress very well	– **can concentrate very well**
– creates a positive atmosphere with his crew	– **solves problems extremely well**
– is very conscientious	– **takes responsibility seriously**
– understands complicated technology	– is regarded as arrogant
– puts concern for others above everything	– has relatively weak leadership skills
– has excellent attention skills	– is regarded as a "know-it-all"
– **has difficulty communicating ideas**	– has a hot temper
– **is regarded as egocentric**	– is considered moody
– **is not very willing to further his education**	– is regarded as a loner

The decision case deals with an airline looking to fill the position of a pilot for long-distance flights; the four Candidates A, B, C, and D are characterised by the attributes listed; shared information is given in bold.

recent meta-analysis of hidden profile studies (Lu, Yuan, & McLeod, 2012) consistently show, groups typically fail to solve hidden profiles.

To illustrate this failure let us take a closer look at the results from one of our own hidden profile studies (Greitemeyer, Schulz-Hardt, Brodbeck, & Frey, 2006). In this study three-person groups worked on four subsequent decision cases. Three of these cases had a hidden profile distribution of information, whereas one of them was a manifest profile. Each of the cases comprised three decision alternatives, forming a clear rank-order in decision quality. Whereas in the manifest profile case this rank-order was already present in the group members' individual information sets (i.e., the alternative that was best based on all information also had the best relation

of advantages and disadvantages in each group member's individual information set), the members' individual information sets in the hidden profile cases reversed this rank-order. In other words, in the hidden profile cases the particular alternative that was best based on all information initially appeared to be the least suited to each group member (vice versa for the worst alternative).

Now, as the results of this study show, groups had no difficulty in detecting this rank-order when dealing with a manifest profile distribution of information: The vast majority of groups (89%) chose the best alternative, whereas only a small proportion of groups chose the second best (7%) or the worst alternative (4%). The opposite happened in the hidden profile cases. Most of the groups chose the worst alternative (87%)—that is, the one that *appeared* to be superior in the group members' initial individual materials—and only very few groups decided for the second best (6%) or the best alternative (7%). In other words: Groups are able to realise a high decision quality in situations where their individual members would already realise a high decision quality (manifest profile). Ironically, however, they fail to do so in the very situation where they have the opportunity to achieve synergy by realising a surplus in decision quality compared to what would have been possible without group interaction.

To further illustrate this point we have reanalysed the data published in our Greitemeyer et al. (2006) study. For these purposes we have calculated the baselines for the tests of weak and strong synergy, and we have done that separately for the manifest profile case and for the hidden profile cases. As already outlined, strong synergy occurs only if the group decision is better than the best individual decision that any of the group members has initially made. With regard to this, all groups contained at least one member who favoured the best alternative prior to discussion. As a consequence there was no room for strong synergy (ceiling effect). This picture was almost the same for weak synergy: For weak synergy to occur, the group decisions have to be better than the average individual decisions. In the manifest profile case 90% of the group members already chose the best alternative prior to discussion, 5% chose the second best, and another 5% chose the worst. Thus, once again we can see that in a manifest profile hardly anything can be gained from having a group decide the issue—and hardly anything was gained, because the real group decisions were almost identical with this latter baseline (as illustrated in Figure 1a).

This is completely different in the case of a hidden profile. As can be seen in Figure 1b, here a very high potential for weak synergy was present: Prior to discussion, 88% of the group members favoured the worst option, 4% favoured the second best, and 8% favoured the best. Hence average individual decision quality was low, as would be expected given the insufficient and misleading individual information. Even for strong synergy

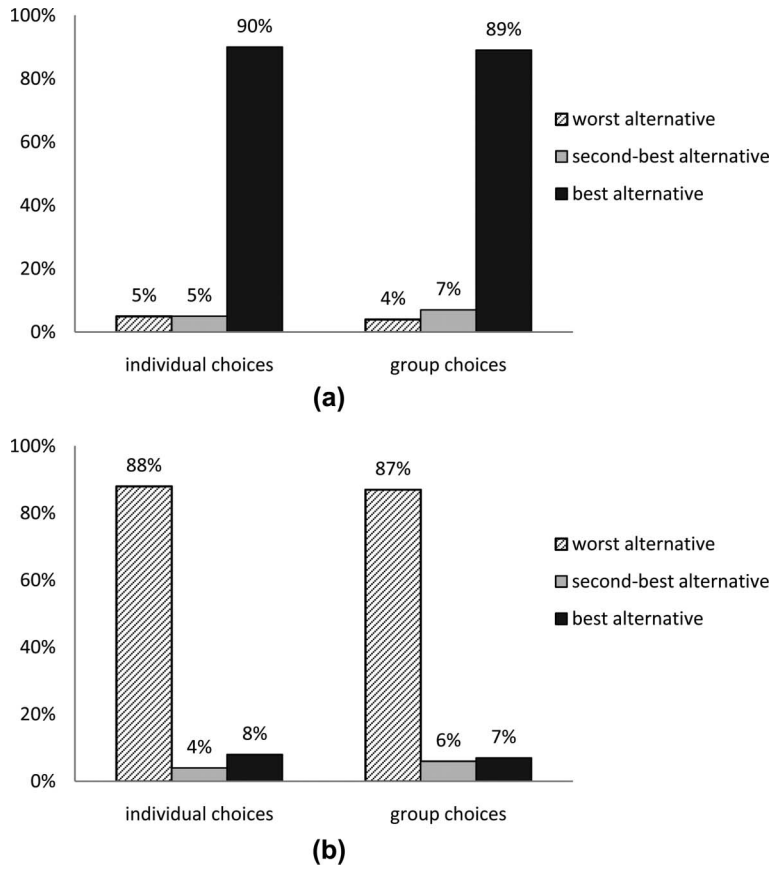

Figure 1 (a) Individual decision quality prior to discussion vs group decision quality in the manifest profile case (Greitemeyer, Schulz-Hardt, Brodbeck, & Frey, 2006). **(b)** Individual decision quality prior to discussion vs group decision quality in the hidden profile cases (Greitemeyer, Schulz-Hardt, Brodbeck & Frey, 2006).

the potential was high: In about three out of four cases all three members initially favoured the worst option, which means that strong synergy would occur if the second best or best alternative is chosen by these groups. Furthermore, in the 7% of the cases where the best individual decision was for the second best option, a group choice of the best alternative would also have yielded strong synergy (and only for the 17% of the groups containing one member who initially preferred the best option, no strong synergy was possible). However, as the comparison with the real group choices in Figure 1b shows, both types of synergy failed to materialise, because group decision quality was more or less at the level of the average individual

decisions—although groups theoretically had much more information than their individual members initially had, and although that additional information would have allowed them to detect the best option.

Taken together, this reanalysis shows that groups reach a fairly high decision quality in situations where—in terms of decision quality—nothing can be gained from having groups as decision makers. In contrast, in the very situation where they have the potential to achieve synergy and thereby make group decision making pay off in terms of decision quality, they typically fail to do so (for a more extensive discussion of this issue, see Mojzisch & Schulz-Hardt, 2011). As a consequence, if we want to continue using groups as a tool for increasing decision quality, we have to find out what particular processes hinder groups from solving hidden profiles and, in turn, how synergy in group decision making can be facilitated.

In two earlier publications (Brodbeck et al., 2007; Mojzisch & Schulz-Hardt, 2006) we have already suggested a model that tries to give answers to these questions. However, some of our recent studies have led to the necessity to substantially revise and further develop this model, particularly by shifting the focus from biases in group information processing to the intensity of group information processing. In the next section we will outline our new, revised model, and we will describe hidden profile studies supporting and illustrating the claims made in this new model.

HURDLES FOR SYNERGY IN GROUP IN DECISION MAKING: A GENERAL MODEL AND EMPIRICAL EVIDENCE

A general categorisation scheme

As outlined in the previous sections, a true potential for synergy in group decision making arises only if the exchange of information in a group changes the decisional implication of the information available to group members. From this boundary condition we derive the general proposition that the realisation of such synergy requires that decision-relevant information is (a) discussed in the group and (b) individually processed by group members. Discussion encompasses the introduction of information in the group (i.e., mentioning information for the first time) and its repetition by the same or other group members (i.e., something that was introduced before is taken up at a later point in the discussion). By processing we mean the encoding, storage, interpretation, and evaluation of information that is discussed in the group. The necessity of both processes for the realisation of synergy is hardly surprising in itself, but since most research on hidden profiles has only addressed the discussion of information, without taking

into account how and to what extent the information discussed is processed by the group members, we felt that this point has to be emphasised.

Furthermore, it can be derived that both the discussion of information and the processing of the information discussed have to be characterised by two qualities: a sufficient *intensity* and a sufficient *lack of bias*: Only if a sufficient amount of information is exchanged, and only if the group members process the information discussed in the group sufficiently to realise its implications, do group members have a chance to detect the superiority of an alternative that initially did not appear to be that strong. At the same time, if biases cause the group to discuss too little information in favour of this particular alternative, or cause group members to evaluate this information too negatively, the hidden profile will also not be solved (what we particularly mean by "bias" and what would be an unbiased discussion or processing will be specified in the corresponding sections below). Once again, this proposition is rather straightforward, but due to the fact that empirical hidden profile research has been far more been concerned with biases (in particular, with discussion biases) than with the intensity of the discussion and processing of information, it is important to emphasise that both qualities are necessary.

The combination of the two processes *discussion* and *processing* with the two characteristics *intensity* and *bias* gives a 2×2 matrix which is illustrated in Figure 2 and which is the basic organising principle of our model. The processes in each of the four cells have to be positively manifested (i.e., sufficient intensity and lack of bias in both discussion and processing of the information discussed) in order to allow groups to solve hidden profiles. In contrast, a negative manifestation of any of the processes in any of the four cells (i.e., insufficient intensity, insufficient processing, biased discussion, biased processing) can be sufficient to completely hinder groups from solving hidden profiles. Unfortunately the "default mode" of both how groups exchange information and how information from group

	Intensity	*Bias*
Discussion of information (group level)	Insufficient discussion intensity (e.g., due to premature consensus seeking)	Discussion biases in favor of shared and preference-consistent information
Processing of information (individual level)	Superficial processing of information (e.g., due to suboptimal encoding conditions during discussion)	Evaluation biases in favor of shared and preference-consistent information

Figure 2. Classification scheme for impairments to the solution of hidden profiles.

discussions is processed individually works against the solution of hidden profiles. In other words, it is rather the rule than the exception that the processes in each of the four cells of Figure 2 have negative manifestations. In the following we will illustrate this unfortunate situation for each of the four cells by referring to exemplary hidden profile research, with a particular focus on our own studies.

Discussion bias

As already outlined, hidden profile research so far has prioritised group discussion at the expense of processing of the information discussed, and it has been far more concerned with biases than with the general intensity of group discussion and, to a lesser extent, individual information processing. Hence most previous hidden profile studies have addressed biases in group discussions as a reason for the failure of groups to solve hidden profiles.

Generally, we speak of a discussion bias if the mentioning and/or repetition of information is not representative of the overall information set available to the group members. For example, if in a personnel selection case 60% of the available pieces of information are positive (i.e., advantages of particular candidates) and 40% are negative (i.e., disadvantages), and if then 70% of the pieces of information that are introduced into discussion are negative, we would call this a bias in favour of negative information.

At least for the first 10 years since the initial Stasser and Titus (1985) study, research on information pooling and hidden profiles in groups almost exclusively dealt with one particular discussion bias: the *bias in favour of shared information*. As we have seen in our exemplary decision case from Table 1, solving a hidden profile requires the group to exchange and integrate their members' unshared information, because in a hidden profile a large portion of the information in favour of the best alternative is—by definition—unshared. Now, the most robust and well-replicated finding in the group information pooling literature is that groups discuss more shared than unshared information (for a summary, see the meta-analysis by Lu et al., 2012). Specifically, this discussion bias means that more shared than unshared information is introduced into group discussion and, once introduced, shared information is also repeated more often than unshared information, with the latter being true both for self-repetitions (i.e., the same member who introduced the piece of information also repeats it) as well as for repetitions by other group members (e.g., Larson, Foster-Fishman, & Keys, 1994). To put it crudely, group discussions focus on what everybody has already known prior to discussion.

This bias stems from stochastic rather than psychological processes: The group will only fail to discuss a shared piece of information if all group members independently forget to mention or are unwilling to mention this

particular piece of information. In contrast, if an unshared piece of information is not mentioned by the one group member who holds it, there is nobody who can compensate for this neglect. Thus, as long as the probability of mentioning any given piece of information is not 0 or 1, a stochastic bias in favour of shared information is inevitable (Stasser & Titus, 1987).[3]

Importantly, the critical information for solving a hidden profile (i.e., advantages of the best and disadvantages of the other alternatives) is not only predominantly unshared, but is also predominantly inconsistent with the group members' initial preferences. Because in a hidden profile the best alternative is, by definition, not evident from the group members' individual information, most or all members will favour other alternatives prior to discussion. Thus the advantages of the best alternative will be inconsistent with the members' initial decision preferences, as will be the disadvantages of the particular alternative that a group member initially favours. In our example from the previous section (Table 1), group members can be expected to favour either A, B, or D prior to discussion. Thus most of the pieces of information that are critical for choosing C (the best alternative)—the advantages of C as well as the disadvantages of A, B, and D—will be preference-inconsistent.

Interestingly, in their seminal study Stasser and Titus (1985) had already predicted that group discussions would be biased not only in favour of shared information, but also in favour of preference-consistent information. However, it took more than a decade before the first experimental test of this idea was published (Dennis, 1996). In his experiment six-person groups that either worked face-to-face or used computer-mediated communication discussed which of three students should be given admission to the university. Information was distributed as a hidden profile. Results showed the already well-known bias in favour of shared information, but when analysing the unshared information separately Dennis showed that, independent of the communication mode, members mentioned more information supporting their initial preferences than neutral information

[3]For the repetition of shared versus unshared information this bias seems to be less inevitable, because once an unshared piece of information is introduced, all group members have the possibility of repeating it. Some researchers have thus tried to explain this part of the discussion bias in favour of shared information with psychological concepts, particularly referring to social validation: Because the veracity of shared information can be confirmed by other group members, it appears more credible and, in consequence, gets repeated more often (e.g., Wittenbaum et al., 1999). We will not go into the details of this reasoning because, according to some critical replications that we conducted, the evidence for this approach is based on a methodological shortcoming of the original studies and when controlling for this shortcoming no evidence for a social validation explanation of biased repetitions favouring shared information can be found (Mojzisch, Kerschreiter, Faulmüller, Vogelgesang, & Schulz-Hardt, 2012).

or information contradicting their initial preferences. The shared information had to be left out of this analysis, because in a hidden profile sharedness and preference-consistency of information are, at least partially, confounded (i.e., a large part of the shared pieces of information is also preference-consistent).

To avoid this problem and hence to demonstrate that there is a *general* discussion bias in favour of preference-consistent information (independent of whether information is shared or unshared), in a very recent study (Faulmüller, Mojzisch, Kerschreiter, & Schulz-Hardt, 2012) we used a non-hidden profile information distribution (all alternatives were designed to be equally attractive). The second aim of this study was to show that—in contrast to the discussion bias in favour of shared information—the discussion bias in favour of preference-consistent information has psychological roots. In two experiments participants exchanged information with a partner in order to prepare a collective personnel decision. Because the partner was either a bogus partner in a written information exchange (participants received standardised written messages prepared by the experimenter) or a confederate of the experimenter in a face-to-face discussion, we had full experimental control over the partner's communication behaviour. In each of the two experiments we manipulated whether the partner favoured the same or a different job candidate than the participant, and whether or not the partner indicated that s/he understood why the participant favoured her/his preferred candidate. To illustrate, if a participant in the experimental condition with "congruent preferences and understanding" had a preference for candidate A, the bogus partner said, "I, too, believe A is the better candidate, and, like you, I would choose him. And, given the information you just passed on to me, I also understand why you prefer him." In contrast, in the experimental condition with "congruent preferences and non-understanding", the bogus partner said, "I, too, believe A is the better candidate. But, given the information you just passed on to me, I don't understand why you prefer him." Analyses of the written messages transferred to the partner (Experiment 1) or the videotapes of the discussions (Experiment 2) allowed us to measure to what extent the participant mentioned preference-consistent versus preference-inconsistent information about the job candidates. Across both experiments there was a clear predominance of preference-consistent information being mentioned. Furthermore, whereas the partner's preference (similar or dissimilar to the participant's preference) hardly affected this predominance, preference-consistent information sharing was particularly strong when the partner said that she did not understand why the participant held her or his preference, as compared to when the partner stated that s/he understood this preference. Figure 3 illustrates this pattern for the results of Experiment 2 (the face-to-face discussions).

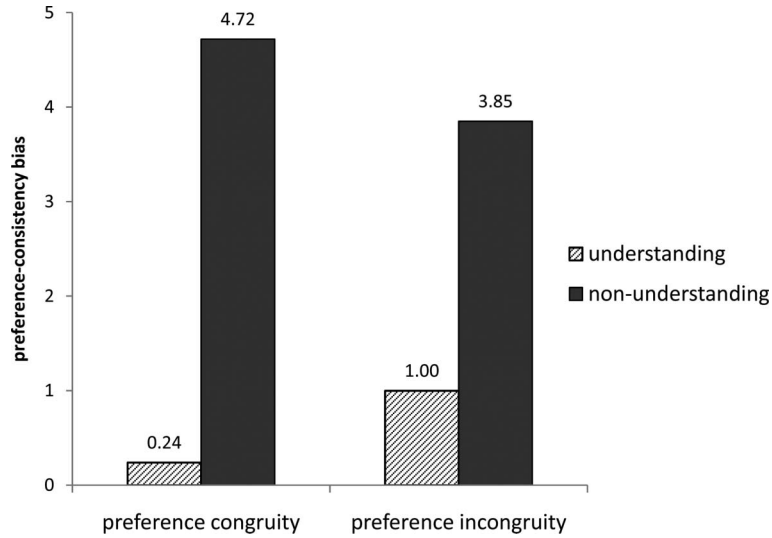

Figure 3. Preference-consistent information sharing (number of preference-consistent pieces of information minus number of preference-inconsistent pieces of information communicated by the participants) dependent on preference congruity and preference understanding (Faulmüller, Mojzisch, Kerschreiter & Schulz-Hardt, Expt. 2, 2012).

These findings inform us about possible motivational underpinnings of the discussion bias in favour of preference-consistent information. Whereas a motivation to convince the discussion partner does not seem to be the driving force here (in this case we would have expected a particularly strong bias if the partner's preference is incongruent with the participant's preference), a motivation to be understood by the partner could be an underlying motive of this bias: As Stasser and Titus (1985) had already assumed, group members might implicitly take an "advocacy role" during discussion; that is, their conversation behaviour is driven by the attempt to explain to the other group members why they hold a particular preference—and explaining a preference means mentioning information that is consistent with this preference.

In addition, one of our other recent experiments (Mojzisch, Grouneva, & Schulz-Hardt, 2010) hints at the possibility that cognitive factors might also be responsible for the preference-consistent discussion bias: As we will outline below in the section on biased information processing, people have a general tendency to attribute a higher quality to preference-consistent as compared to preference-inconsistent information. Hence, if people simply want to communicate the best information (in terms of credibility, reliability, and information strength), they should predominantly mention preference-consistent information. In other words, group members might

discuss in a preference-consistent manner without intending to do so. The Mojzisch et al. (2010) study provides some data in accordance with this interpretation. In this study participants first received information about two decision alternatives and were asked to indicate their preference. Next they were asked to evaluate the quality of each piece of information. Thereafter participants should imagine being the one to open a discussion and to write down six pieces of information they would contribute to the discussion. Our results provided evidence for both an evaluation bias favouring preference-consistent information and a discussion bias favouring preference-consistent information. Furthermore, these two biases were significantly correlated. This finding suggests that group members may be more likely to mention preference-consistent than preference-inconsistent information simply because preference-consistent information is judged to be more accurate and relevant than preference-inconsistent information. However, the correlational nature of this result has to be taken into account. In addition, since we only measured intentions to discuss particular pieces of information (rather than real discussion behaviour), firm conclusions are not possible yet.

So far we know that group discussions are characterised by biases towards shared information on the one hand and preference-consistent information on the other hand. But do we also know that these biases play a causal role in the failure of groups to solve hidden profiles? The answer to this question is a ''yes'' and a ''no'' at the same time. The reason for this twofold answer lies in the (at least partial) confound between sharedness and preference-consistency that is inherent in hidden profiles. As a consequence, the hidden profile studies so far do not allow us to calculate independent measures of both biases and independently test their causal role for the failure of groups to solve hidden profiles.[4] Instead we usually have a composite measure incorporating both the sharedness and the preference-consistency bias (although a vast number of studies failed to acknowledge this and labelled the bias purely in terms of sharedness). Thus if in a hidden profile study a discussion bias favouring shared information is found—that is, group members exchange more shared than unshared information—we have to keep in mind that this bias may also be a result of the fact that group members are more likely to discuss preference-consistent than preference-inconsistent information. In other words, in case of a hidden profile, the

[4]Theoretically, it would be possible to construct a hidden profile that allows for an independent assessment of the sharedness bias on the one hand and the preference-consistency bias on the other hand. However, because this requires a substantial amount of unshared preference-inconsistent as well as shared preference-consistent information (and even more shared preference-consistent and unshared preference-inconsistent information, because otherwise it is not a hidden profile), the overall amount of information in this hidden profile would be high.

sharedness bias is not a pure sharedness bias but rather a composite measure fuelled by both the tendency to discuss more shared than unshared information and the tendency to discuss more preference-consistent than preference-inconsistent information.

For this composite measure it has been shown that, on average, a stronger discussion bias leads to lower decision quality (Lu et al., 2012; Schulz-Hardt et al., 2006). Hence we know that focusing discussion on shared and preference-consistent information is detrimental for decision quality, but the relative contributions of the two biases have not been identified yet.

Discussion intensity

Even the complete absence of any bias in favour of shared and/or preference-consistent information will not help if the information exchange in the group is quantitatively insufficient. This does not only mean that enough information has to be *introduced* into group discussion. Because hearing a piece of information for the first time during an ongoing group discussion does not automatically mean that one will still be aware of this piece of information later on when the final decision is made, sufficient *repetition* and sufficient *time* to discuss pieces of information are also crucial.

Sufficient discussion intensity (i.e., that enough information is discussed, that information is repeated, and that here is enough time to discuss the information and think about it) cannot be taken for granted. For example, time restrictions—which are present in many group decision-making settings in the real world—can decrease discussion intensity and thereby lower the solution rates of hidden profiles (Campbell & Stasser, 2006). Furthermore, without sufficient epistemic motivation (i.e., a motivation to find the most accurate solution; cf. Kruglanski & Webster, 1996) information exchange in the group may remain superficial and hence insufficient to detect the superiority of the best alternative (Scholten, van Knippenberg, Nijstad, & De Dreu, 2007).

However, even if sufficient time and motivation to find the best solution are given, a fundamental dynamic in groups works against the solution of hidden profiles: The implicit or explicit goal of group decision making is consensus. As a consequence, group discussions typically start with group members exchanging their initial decision preferences. For example, in our Schulz-Hardt et al. (2006) experiment, 80% of all groups opened the discussion with group members stating who favours which candidate (even higher rates are reported by Gigone & Hastie, 1993). If a consensus emerges at this early stage, it is highly likely that only a very superficial information exchange will take place and, because in a hidden profile hardly anyone favours the best alternative at the beginning, the early

consensus will be in favour of a suboptimal alternative. Interestingly, if we reanalyse the data of the Schulz-Hardt et al. (2006) experiment we see that only 22% of all groups with initial preference exchange solved the hidden profile, whereas 55% of the groups did so if they avoided this initial preference exchange.

Whereas this evidence is correlational, in a more recent study we experimentally manipulated whether or not groups exchanged their initial preferences (Mojzisch & Schulz-Hardt, 2010, Expt 4): Whereas half of the groups were instructed to start the discussion by exchanging their group members' preferences, the other half of the groups were told that they should withhold any preference exchange until they felt that they had finished the exchange of information. As predicted, the results showed that groups without initial preference exchange had a significantly higher discussion intensity (as measured by the introduction and the repetition of information) and solved the hidden profile significantly more often (40% vs 7%) than groups with such initial preference exchange.

As outlined above, the consensus-seeking tendency of group discussions works against discussion intensity and thereby impedes decision quality in hidden profiles. If this is the case, then groups should be particularly unlikely to solve hidden profiles if they consist of members who all favour the same (suboptimal) alternative at the beginning, and decision quality should be higher if pre-discussion dissent is present to some extent. In an earlier study (Brodbeck, Kerschreiter, Mojzisch, Frey, & Schulz-Hardt, 2002), we had already obtained some support for this idea, but similar to other studies in the literature that reported effects of pre-discussion dissent (e.g., Scholten et al., 2007), this dissent was confounded with the accuracy of the initial preferences, because dissent often came from a person who favoured the best solution right at the beginning. Hence we put this idea to a more rigorous test in our Schulz-Hardt et al. (2006) experiment.

Using the material from Table 1 we manipulated whether groups consisted of members who all favoured the same suboptimal candidate A, B, or D prior to discussion, or whether pre-discussion dissent was present to some extent (i.e., either one member favoured a different candidate from the other two members, or all three members had different preferences). Within these dissent conditions we further manipulated whether, as in the consent condition, all preferences were in favour of suboptimal alternatives (e.g., two members favour Candidate B, and one members favours Candidate D) or whether the group contained a proponent of the best alternative (e.g., two members favour Candidate B, and one member favours Candidate C). Results showed that dissent groups, irrespective of whether or not they contained a proponent of the best alternative, scored higher than consent groups on all three measures of discussion intensity: Dissent groups introduced more information into discussion, they repeated introduced

information more often, and they discussed longer than consent groups. With regard to decision quality, dissent groups solved the hidden profile more often than consent groups, even if all members of the dissent groups initially favoured a suboptimal alternative (27% vs 7%, pure dissent effect). If, however, one of the members of the dissent groups favoured the best candidate right from the beginning, solution rates were even higher than in dissent groups without a proponent for the best candidate (62% vs 27%, proponent dissent effect).

The results of this experiment are particularly well suited to shed light on *how* discussion intensity mediates decision quality. As illustrated in Figure 4, for both the pure dissent effect and the proponent dissent effect, the proximal mediator (i.e., the variable that directly affected decision quality) was the amount of discussion (i.e., both the introduction and the repetition of information) about the best candidate (Candidate C). This is not surprising, because (only) if Candidate C is sufficiently discussed, the superiority of this candidate will become evident. However, whereas it is clear that the existence of a proponent for Candidate C in the group will directly lead to more discussion of this candidate (consequently, no other mediator was involved for the proponent dissent effect), such direct influence is unlikely in the case of dissent among members who all favour different candidates other than C. In line with this reasoning, discussion intensity and discussion bias (with both measures excluding information about Candidate C to avoid confounds between the mediator and the dependent variable) were shown to mediate the pure dissent effect on the

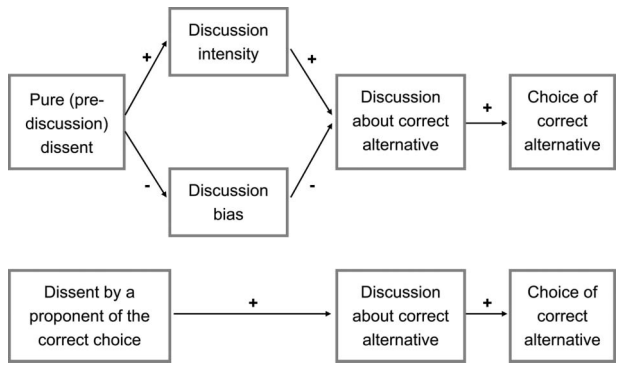

Figure 4. Theoretically predicted and empirically validated mediation of dissent effects on decision quality. Copyright © 2006 by the American Psychological Association. Reproduced with permission. The official citation that should be used in referencing this material is Schulz-Hardt, S., Brodbeck, F. C., Mojzisch, A., Kerschreiter, R., & Frey, D. (2006). Group decision making in hidden profile situations: Dissent as a facilitator for decision quality. *Journal of Personality and Social Psychology, 91,* 1080–1093. The use of APA information does not imply endorsement by APA.

discussion of Candidate C. In other words, if a group fails to discuss the best candidate sufficiently, this can be either because the group generally has too little discussion intensity or because group discussion is biased in favour of shared and preference-consistent information (which works against discussing the predominantly unshared and advantageous information about Candidate C). Because dissent increased discussion intensity and decreased discussion bias, it facilitated discussion about the best alternative and, in turn, solution of the hidden profile.

We think that this type of mediation analysis would be beneficial for almost all studies relating discussion content to the solution of hidden profiles. Usually, what is done in hidden profile studies is to focus on particular discussion content measures that are close to the criterion (decision quality) like, for example, discussion of the best alternative (e.g., Hollingshead, 1996), discussion of the critical unshared cues (e.g., Stasser, Stewart, & Wittenbaum, 1995) or, more generally, discussion of unshared information (e.g., Winquist & Larson, 1998). It is, then, rather straightforward that these measures are often associated with decision quality, whereas other complementary measures (e.g., discussion of shared information) are not. However, the crucial question is how groups come to discuss this critical information, given that they usually do not know in advance that it is critical. In our view, high intensity or low bias are the two paths to achieve this goal: Groups discuss the information that is critical for solving the hidden profile either because they generally discuss a lot of information extensively, or because they consider information about all of the alternatives in a balanced manner (or both). Hence, to find out to what extent the discussion of the critical information is due to high intensity or low bias, it would be helpful to have general and theoretically independent measures of discussion intensity and discussion bias (like the ones in our Schulz-Hardt et al. study outlined above) in hidden profile experiments.[5]

Processing bias

Beginning with Stasser and Titus (1985), for almost 20 years reasons for the failure of groups to solve hidden profiles had been sought exclusively at the group level. The underlying idea of this research was always: If the groups

[5]Lu et al. (2012) draw a distinction between *information coverage* and *discussion focus*. Although somewhat overlapping with our distinction between discussion intensity and discussion bias, both concepts are narrower than the ones we use. Whereas information coverage only captures the introduction of information into discussion, discussion focus only addresses one of the two fundamental biases that we identified: the bias in favour of shared information. Furthermore, in their meta-analysis these authors restrict the information coverage measures to coverage of *unshared* information, thereby introducing partial dependence between the information coverage and the information focus measures.

fail to reach synergy in group decision making, something must have gone wrong at the group level. By contrast, one of the core themes of our own research programme during the last 10 years was to show that this group-level approach is incomplete and has to be complemented by explanations that are located at the level of individual information processing.

The starting point of this part of our research was a study conducted by Greitemeyer and Schulz-Hardt (2003). The general idea of this study was: If the failure of groups to solve hidden profiles is completely due to group-level processes, then individuals who are provided with the protocol of a group discussion where none of the dysfunctional group processes is present (i.e., full and unbiased information exchange) should have no problems making the best decision in this situation. Hence, participants were first given initial individual information about a decision case. After having formed an initial impression of the decision alternatives and having stated a preference for one of the alternatives, participants did not form groups, but rather received the protocol of a fictitious group discussion. One of the members was labelled "you", the other two were labelled "person 1" and "person 2". In the discussion protocol all the available information was exchanged. Specifically, the person labelled "you" mentioned all the information that the participants had initially received, and the participants got to know all the information of the other group members.

In the first of the two experiments we manipulated whether the information distribution was a manifest profile or a hidden profile. That is, the alternative that appeared to be the best given the participants' individual information sets was also either the best based on the full information in the protocol (manifest profile) or was the worst given the full information in this protocol. As can be seen in Figure 5, participants had no problems solving the manifest profile. However, in the hidden profile information distribution most of the participants chose the worst alternative that initially appeared to be the best one. In contrast, the best alternative, which initially appeared to be the weakest option, was only chosen by a very small minority.

These numbers are particularly intriguing if they are compared to the solution rates in the real group experiment by Greitemeyer et al. (2006) that we have displayed in Figures 1a and 1b. Both experiments are comparable because they used the same information distributions, and the decision case in Experiment 1 by Greitemeyer and Schulz-Hardt (2003) was also used in the Greitemeyer et al. (2006) experiment. As a comparison of the figures shows, the solution rates are almost identical in both experiments, but in one case we have groups with all their (presumed) dysfunctional group processes, and in the other case we have individuals who do not have to suffer from any of these processes. In spite of this fact, the hidden profile was hardly ever solved in the individual case. In Experiment 2 of the Greitemeyer

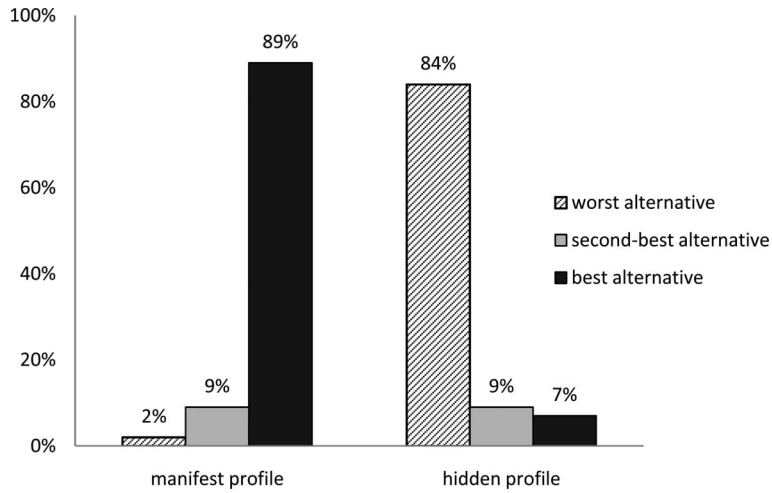

Figure 5. Individual solution rates dependent on the type of profile (Greitemeyer & Schulz-Hardt, Expt. 1, 2003).

and Schulz-Hardt (2003) study we obtained somewhat higher solution rates after we had modified the discussion protocol by introducing a highly structured discussion (much more structured than most real group discussions are), but still the hidden profile was solved only by a minority of the participants, and most participants stuck to their suboptimal initial preference.

In a more recent study (Faulmüller, Kerschreiter, Mojzisch, & Schulz-Hardt, 2010) we went one step further and showed that this perseverance of suboptimal individual preferences persists even if we replace the discussion protocol with the much more neatly arranged group member information lists: Participants were first given their own individual information list (containing their pre-discussion information set) and then, after having formed a preference for one of the alternatives, were given the information that was provided to the other group members. Although this should make the superiority of the best alternative relatively evident, suboptimal individual preferences largely persevered. Taken together, these studies indicate that groups fail to solve hidden profiles even if all relevant information has been exchanged, because their members tend to stick to their suboptimal initial preferences.

To account for this individual preference effect it has been tested whether the *individual processing* of the information discussed is *biased*. As already outlined, individual processing encompasses the encoding, interpretation, evaluation, storage, and retrieval of information. Although biases might occur at each of these stages, research on biased processing has so far exclusively

focused on biases in the *evaluation* of the information discussed. Three such biases have been identified: Similar to the above-discussed biases during discussion, shared information on the one hand and preference-consistent information on the other hand are evaluated more favourably than unshared or preference-inconsistent information. However, the bias in favour of shared information can be further split into two components: a bias in favour of one's own information (*ownership bias* – Chernyshenko, Miner, Baumann, & Sniezek, 2003) and a bias in favour of information that is socially validated by other group members (Wittenbaum, Hubbell, & Zuckerman, 1999).

Because in earlier studies these three biases have been, at least partially, confounded with each other, we conducted an experiment that disentangled them (Mojzisch et al., 2010). For these purposes, participants—as in the Greitemeyer and Schulz-Hardt (2003) study—were first handed out individual information about a decision case, formed an individual preference, and were then provided with a protocol of a fictitious group discussion between them and two other group members. After reading the protocol the participants were asked to rate each piece of information that was mentioned during discussion with regard to its perceived accuracy, strength, and relevance. The information distribution was not a hidden profile, because we had to avoid any confound between sharedness and preference-consistency of information.

As illustrated in Figure 6, participants perceived the information exchanged during discussion to be of higher quality if it supported their initial preferences than if it was inconsistent with these preferences. Furthermore, they felt their own initial information to be of higher quality than the other group members' information, and they rated information higher if it was socially validated (i.e., after a particular piece of information was mentioned in the protocol, one or both other group members confirmed that they also had this information) than if it was not.

As a consequence of these biases, even if during an intensive and unbiased discussion group members are confronted with a lot of information that is new to them and that contradicts their initial preferences, the aforementioned evaluation biases will lead them to underweigh this information, making it more likely that the suboptimal initial preference will persist. In line with this idea, in the Greitemeyer and Schulz-Hardt (2003) study we could show that the individual preference effect was, at least partially, mediated by preference-consistent information evaluation (i.e., preference-consistent information was evaluated as being more reliable, more important, and stronger than preference-inconsistent information). Further evidence for the mediating role of this bias is provided by Rothmund, Mojzisch, and Schulz-Hardt (2011).

In another study (Mojzisch, Schulz-Hardt, Kerschreiter, Brodbeck, & Frey 2008) we could show the same mediation for the evaluation bias in

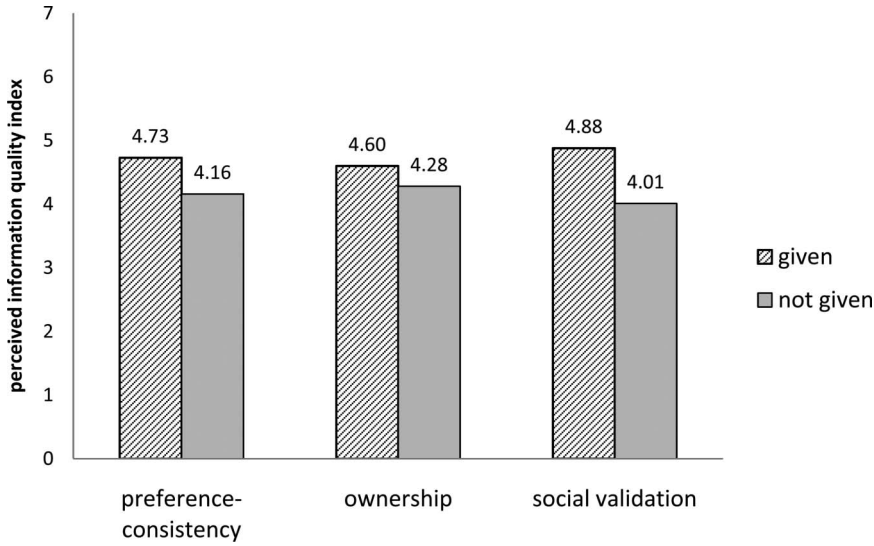

Figure 6. Main effects of preference-consistency, ownership, and social validation on perceived information quality (index of perceived accuracy, strength, and relevance) in the study by Mojzisch, Grouneva, and Schulz-Hardt (2010).

favour of socially validated information, but this time we were able to extend this demonstration beyond discussion protocols (which we again used in the first two experiments of this paper) to face-to-face discussions: In Experiment 3 participants discussed a decision case with two other group members who, in fact, were confederates of the experimenter, trained to show a particular communication pattern that varied in accordance with the experimental condition of the real participant. Specifically, depending on the experimental condition, the confederates socially validated preference-consistent information, preference-inconsistent information, both types of information, or no information at all. The confederates socially validated both items mentioned by the naive participant and items mentioned by each other. In the case of social validation the confederates confirmed that they held the same item. In the case of lack of social validation the confederates noted that the item mentioned was new to them. Both confederates introduced all of their own individual information into discussion, and because a hidden profile distribution was realised the alternative initially favoured by the participant turned out to be suboptimal. As predicted, whereas social validation of preference-consistent information had no effect on whether or not the participants finally revised their preferences and chose the superior option, socially validating preference-inconsistent information increased the likelihood of a successful preference revision. Because in a

hidden profile the crucial information that could lead to the selection of the best alternative is preference-inconsistent and predominantly cannot be socially validated (because it is unshared), these results demonstrate that an evaluation bias in favour of socially validated information works against the solution of hidden profiles.

Processing intensity

Similar to the case of group discussion, where the failure to discuss specific pieces of information does not necessarily need to be a consequence of a bias but could rather also be due to generally insufficient discussion intensity, the failure to integrate a discussed piece of information into one's final preference does not need to be a consequence of a bias. Rather, it could also be due to the fact that the processing of information during discussion is too superficial—which, in our view, can happen quite often. Even if all group members are strongly motivated to find the best alternative (and, as we have initially outlined, such conditions are usually realised in hidden profile experiments), they have to deal with a lot of information that is new to them and that, in many cases, they only hear once or twice during an ongoing, more or less unstructured, group discussion. Given that they also have to keep in mind what they want to contribute to the discussion themselves, it is a tough task trying to process all these pieces of information so intensively that they can all be used when one has to finally decide for one of the alternatives. If, as it likely will, a certain amount of information cannot be remembered when it comes to the final decision, this amount might be enough to make the best alternative undetectable for the group member. Such insufficient processing might be the reason why visualising discussion content (by writing down the discussed pieces of information on a list) has a facilitating effect on the solution of hidden profiles (Voigtländer, Pfeiffer, & Schulz-Hardt, 2009). Interestingly, we usually provide our participants with the opportunity to visualise discussion content (by providing pencils and paper on the desk where the group has its discussion), but only a minority of groups make use of this opportunity.

Although it is highly plausible that group members will hardly remember all information when it comes to making the final decision, insufficient individual processing of the information discussed has almost completely escaped attention in the hidden profile literature. The only exception is the Mojzisch and Schulz-Hardt (2010) study that we mentioned in the discussion intensity section. As we already outlined, the study showed that exchanging preferences at the beginning of a group discussion reduces discussion intensity and decreases the chances that hidden profiles are solved. However, the focus of this study was not on discussion intensity, but rather on processing intensity. The central idea was that getting to know the

initial preferences of the other group members at the beginning of a group discussion will lead to more superficial processing of the information that is exchanged during discussion. We derived this idea from social cognition research showing that the availability of higher-order constructs reduces attention to lower-level cognitions (e.g., Macrae, Milne, & Bodenhausen, 1994). Because each group member forms his/her preference on the basis of his/her individual information set, in a certain sense the preferences represent an aggregation of the individual information sets. Thus if one knows the preference of a particular group member, one might no longer feel the urgent need to know all the individual information of this member.

To test this idea, participants in Experiments 1 to 3 were provided with individual information about a decision case and expected to discuss this case in four-person groups (Expts. 1 and 3) or three-person groups (Expt. 2). Prior to the real discussions (which took place in the end, but were irrelevant for the purposes of the study), participants were provided with the information lists of their fellow group members, thereby making sure that everybody had the chance to consider all the available information. We then manipulated whether or not the other group members' information lists indicated which alternative the participants' fellow group members favoured (preference feedback conditions), and within these preference feedback conditions we also varied the particular preference distribution in the group (e.g., all members had homogeneous preferences, or the participants belonged to the majority in the group, or the participants learned that they were the minority member in the group). The main dependent variables were the participants' individual decisions after having read all information lists, as well as an unannounced recall test at the end of the experimental session on which they were requested to write down all the decision-relevant information that they could remember. This recall test served as an indirect measure of the amount of attention devoted to processing decision-relevant information.

Figure 7 illustrates the results of Experiment 1: Independent of what the particular preferences of the other group members were, any preference feedback decreased the solution rate of the hidden profile (i.e., participants switched to the best alternative less often after having studied the other group members' information lists) as compared to the control condition where the participants knew nothing about the other group members' preferences. Further analyses showed that these differences were due to the fact that participants in the control condition remembered more information in the unannounced recall than did participants in the preference feedback conditions. Finally, mediation analyses showed that the effect of learning the others' preferences on the solution of hidden profiles was mediated by their memory performance in the unannounced recall which, as mentioned above, served as a measure of the attention devoted to encoding

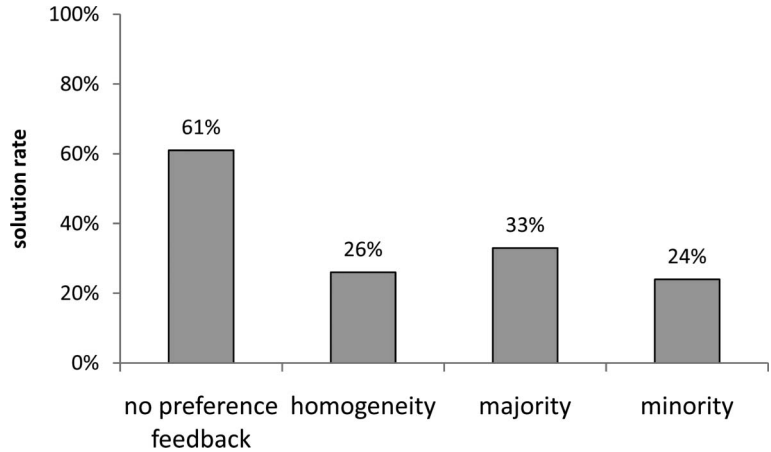

Figure 7. Individual solution rates dependent on preference feedback (Mojzisch & Schulz-Hardt, Expt. 1, 2010).

the information exchanged. Experiments 2 and 3 confirmed and extended these results.

Finally, in Experiment 4 we demonstrated that this mechanism of insufficient processing intensity also extends to real group discussions. As already outlined in the discussion intensity section, we manipulated whether groups started the discussion by exchanging preferences or whether they abstained from stating these preferences until the information exchange was over. After the groups had reached the final decision, participants were separated and received an unannounced recall questionnaire in which they were to write down all the decision-relevant information that they could remember. Results showed that the groups with no preference exchange at the beginning of the discussion solved the hidden profile significantly more often than did the preference exchange group. Moreover, even when controlling for the higher discussion intensity in the no-preference exchange groups, members of these groups had better information recall than members of groups with initial preference exchange, and these differences in processing intensity partially mediated the differences in the hidden profile solution rates. Taken together, the findings of this study indicate that insufficient intensity in the individual processing of the information discussed is an important, so far overlooked, hurdle for the solution of hidden profiles.

Intensity versus bias: On the primacy of intensity

In the foregoing sections we have outlined four categories of processes that are responsible for why groups so frequently fail to solve hidden profiles.

These four categories were made up of two main qualities of handling the decision-relevant information—intensity and (absence of) bias—that have to apply to two levels of information use in the group—group discussion and individual processing of the information discussed. Whereas we think that group discussion and individual processing are equally important for successful group decision making, we do not consider intensity on the one hand and bias on the other hand to be of equal importance. Quite obviously, without sufficient intensity in discussion or processing even a complete lack of bias will not help, because the group members will not exchange sufficient decision-relevant information in order to recognise the superiority of the best alternative. Thus sufficient intensity is a necessary condition for the solution of hidden profiles. In contrast, even with a strong bias in group discussion and/or group members' processing of information, high discussion and processing intensity can still lead to the solution of hidden profiles, because it might still help sufficient crucial information to "come through" so that the superiority of the best alternative is detected.

This primacy of intensity over bias can be justified on both theoretical and empirical grounds. Theoretically, it can be argued that intensity has the potential to override bias. The more intensive a discussion becomes (i.e., the more information is introduced and the more often it is repeated), the less room there is for any bias—in the case of full information exchange any bias is, by definition, gone. Interestingly, the same is also true if discussion intensity is minimised, because if hardly anything is exchanged there is hardly room for any bias (and in the absence of any information exchange, any bias is, by definition, absent). Hence there is a curvilinear relation between discussion intensity and the maximum bias possible, with the largest potential for bias at medium levels of discussion intensity.

Intensity can also override bias at the level of individual processing: Take, for example, the evaluation bias in favour of preference-consistent information. As we know from studies on individual information processing, this bias is due to selective attention allocation: preference-consistent information is accepted at face value, whereas preference-inconsistent information is checked more thoroughly, so that weaknesses are detected given that they exist (Edwards & Smith, 1996). Now, if processing intensity is maximised, this means that all pieces of information (including the preference-consistent ones) are checked thoroughly, thereby eliminating the evaluation advantage of preference-consistent information. (Once again, the same is true if intensity is minimised, because then everything is accepted at face value.)

Empirically, we only know of one study where the relative predictive value of intensity on the one hand and bias on the other hand (with both being measured independently of each other) for the solution of hidden profiles has been compared: the Schulz-Hardt et al. (2006) study. In the data

of this study the association between discussion intensity and decision quality was far stronger than the association between discussion bias and decision quality. Consequently discussion intensity was the much more powerful mediator of the dissent effect on decision quality compared to discussion bias, and if both were tested simultaneously only the former remained a significant mediator. Although the empirical basis is small, these findings nicely complement our theoretical arguments for why intensity should be more important than bias.

IMPLICATIONS, GENERALISATIONS, AND CONCLUSION

What is the model good for?

The general model that we have presented here defines four categories of processes that are responsible for the failure of groups to solve hidden profiles and systematises these categories along the two dimensions of discussion versus processing and intensity versus bias. In the previous sections we have explained how these processes work and how they impede decision quality, and we have given several examples of how these processes can be empirically addressed.

In our view this model is useful both for theoretical as well as for practical purposes. First of all, systematising what we already know about why decision quality is suboptimal in hidden profile situations should be helpful for those who want to get to know the current status of knowledge, independent of whether their interest is primarily theoretical or practical. Then, on a theoretical level, such a general scheme might, for example, be used as a tool in order to classify the various variables that have already been shown to affect the solution of hidden profiles. Obviously, a complete categorisation of all previously identified variables would not yet be possible, because for many variables we do not yet know to what extent they affect the processes in the four categories. At the same time, we think that using the categories to systematise variables known to affect the solution of hidden profiles can further enhance our understanding of synergy in group decision making.

Similarly, the model can help to identify blind spots. Although we believe that the categories as such are exhaustive, we do not think that within each category all of the relevant processes have yet been exhaustively identified. For example, discussion biases have so far been investigated with regard to the introduction and the repetition of information. However, we think it is highly plausible to assume that *asking questions* in group discussions could be subject to at least one of the two biases that have been identified for the other group discussion variables. Although we do not see why group members should predominantly ask for shared information (if anything,

they should ask for unshared information), we can clearly see that a preference-consistency bias could arise in group members' asking behaviour. As we know from selective exposure research, people have a general tendency to predominantly search for information supporting their opinion (Frey, 1986). As our earlier research on selective exposure in group decision making has shown, groups have the same tendency, and this is all the more the case the more a consensus in favour of a particular option is already present in the group (Schulz-Hardt, Frey, Lüthgens, & Moscovici, 2000; Schulz-Hardt, Jochims, & Frey, 2002). Hence, particularly in groups with little or no dissent—which, as we have discussed, are particularly unlikely to solve hidden profiles (Schulz-Hardt et al., 2006)—we should expect group members to selectively ask each other whether they have additional information in favour of the preferred or in disfavour of a non-preferred option. As far as we know, no studies on this topic have yet been published.

Another example of an explanatory shortcoming is the so-far underdeveloped literature on individual information processing in hidden profile situations. As we have outlined, processing biases have so far been exclusively localised at the stage of information evaluation. However, it is plausible that processing stages like encoding, storage, and retrieval are also subject to biases in hidden profile situations. For example, participants might have a systematic tendency to remember more preference-consistent than preference-inconsistent information after group discussion, and this might contribute to the maintenance of their suboptimal initial preferences. Similarly, apart from the Mojzisch and Schulz-Hardt (2010) study, we hardly know anything about group-specific variables moderating individual processing intensity in group discussions, and it is at least plausible that variables like leadership style (Larson, Foster-Fishman, & Franz, 1998) or discussion structuring (Stasser, Taylor & Hanna, 1989) that have been shown to moderate discussion intensity also affect processing intensity.

Or, to give one last example of how future research could be stimulated by the model: So far, only little is known about how the four types of hurdles that are outlined in our model *interact* with each other. There is one obvious relation that we have outlined—that maximising or minimising intensity both eliminate biases. Furthermore we have shown that at least in one case a process from one of the cells of our model (preference-consistent evaluation of information) seems to partially mediate a process from another cell (preference-consistent discussion of information). However, more such interrelations and interactions are plausible and could be tested. To name just one possibility, strong discussion biases might (somewhat paradoxically) lead to less or even contrary biases in the processing of this information: If very little unshared or preference-inconsistent information is discussed, the "exceptional" nature of this information might be highly salient which, in turn, might give it an advantage regarding the depth of processing.

On a practical level, the model could guide the search for interventions aimed at facilitating decision quality in hidden profile situations. As can be derived from the model, ideally such an intervention should be able to intensify both the discussion of information and the processing of the information discussed, and it should also de-bias both the discussion and the processing of the information discussed. However, this is a high expectation to live up to, and it should be noted that we do not yet know of any variable that has been shown to affect all four categories of processes. If, hence, priority has to be given to some of the processes, then we would suggest that priority be given to enhancing discussion and processing intensity in the group. The theoretical reasons for this priority have also been given in our "intensity versus bias" section, but we also see a practical advantage of this priority: The discussion and evaluation biases in favour of shared and preference-consistent information are hard to address. As we have explained, the discussion bias in favour of shared information is primarily a stochastic rather than a psychological phenomenon, and no psychological intervention can change the laws of probability. Furthermore, the evaluation biases in favour of shared and preference-consistent information (with the latter also partially causing the corresponding discussion bias) stem from general principles of human information processing, so de-biasing is not that easy. And although there are some studies in the literature showing that group discussions can be de-biased, thereby facilitating the solution of hidden profiles (e.g., Galinsky & Kray, 2004; Postmes, Spears, & Cihangir, 2001), we doubt that manipulations like the ones in these studies (e.g., thinking about a counterfactual question prior to the main decision case) will be easily applicable outside the laboratory. In contrast, discussion and processing intensity can be addressed relatively easily, for example by simply dividing the group decision-making session into an information exchange phase and a subsequent preference exchange and negotiation phase (Mojzisch & Schulz-Hardt, 2010), by emphasising the need for open information exchange and extensive discussion and processing prior to reaching an agreement (van Ginkel & van Knippenberg, 2009), or by holding the group members accountable for the decision-making process (Scholten et al., 2007). Interventions like this might not seem as sophisticated as de-biasing techniques, but they might be easier to apply—and more helpful.

Bold claims from the perspective of a narrow paradigm?

At the beginning of this chapter we claimed that our model outlines the types of processes that impede the realisation of synergy in group decision making in general. In alleged contrast to this bold claim, we then relied exclusively on research using the hidden profile paradigm—could this perspective be too narrow to justify our rather bold claims? As we have initially outlined, synergy in group decision making (and particularly strong

synergy) is only possible if group interaction can lead to the detection of a superior decision alternative, and the superiority of this alternative was not evident to group members individually. This is the defining criterion of a hidden profile—thus we think that the focus on this paradigm is inevitable if we want to learn something about synergy in group decision making. Nevertheless, one might argue that most empirical hidden profile studies go a little step further than the definition and introduce an additional difficulty: The defining criterion of hidden profiles would be fulfilled if that particular alternative that is best given the full information is *not better* than other alternatives in the members' individual information, whereas in most empirical studies this best alternative appears to be the *weakest* initially. Although it is clear that this characteristic further lowers the solution rates (studies by Henningsen & Henningsen, 2003, as well as Kelly & Karau, 1999, illustrate this), we do not see that this modification changes the general nature of the processes involved. In other words, even more discussion and elaboration intensity and even less bias in the discussion and elaboration of information might be needed to detect the right choice if it initially appears to be the worst option, but we do not see that any of these processes lose their importance or that any additional process comes into play if this alternative initially is on par with one or more other options.[6]

But what about another critique that is often raised against the hidden profile paradigm: its alleged lack of mundane realism? It is often argued that the hidden profile paradigm in its current form lacks crucial features of group decision making in the "real world" (e.g., Wittenbaum, Hollingshead, & Botero, 2004): Whereas, for example, in hidden profile studies all participants are cooperatively motivated and have the single goal of finding the best alternative in the group, in real group decision-making contexts group members often have vested interests and behave strategically in order to push the particular alternative that is advantageous for themselves, not necessarily for the group or the organisation. Although this is certainly true, we think that this critique misses the point. The hidden profile paradigm was never designed to be a realistic portrayal of group decision making in any and all political, economic, or other contexts. Rather, it serves as a tool to investigate what fundamental individual and group processes might impede

[6]In our view the same is true for another type of situation that does not fall under the strict definition of a hidden profile, but that might nevertheless be considered as bearing the potential for synergy: What if the superiority of the best option is evident to one or more group members prior to discussion, but these group members only represent a minority in the group? In accordance with Larson (2010), such a situation would, at least, bear the potential for weak synergy, because the group decision can turn out to be better than the average individual decision prior to discussion. We are convinced that the solution of such "partial hidden profiles", as one might call them, depends on the same processes as the solution of "full" hidden profiles.

the realisation of synergy even if everybody wants to realise these synergetic gains. Of course, if members withhold information because their own interest differs from the group interest and, thus, they want to hinder others from finding out what's best for the group, then the group will not solve a hidden profile. Similarly, if the group is dominated by a directive leader who, unfortunately, favours a suboptimal solution, then it is highly likely that the group will make a suboptimal decision in the end. We do not think that people need a social psychologist to understand such effects.

Without any doubt, group decision making in practice faces additional challenges to those present in hidden profile studies. However, these additional challenges are—at least in our view—not specific to the (non)realisation of synergy, but rather might generally affect individual and group decision quality in any situation (e.g., the directive group leader might enforce a solution although it is evident to most or all other group members that this alternative is a very suboptimal one). In contrast, the hidden profile paradigm and our model capture processes that are *specific* to synergy in group decision making and hence can help explain why this synergy is often absent even under conditions that might be considered to be optimal for group decision making.

Nevertheless, there is—at least—one limitation of the hidden profile paradigm that has to be mentioned and conceded here: Because it is almost impossible to identify hidden profiles in the field, nobody knows how frequent they really are in practice. We can confidently say that they should occur less often than manifest profiles because, unless some very strong biases underlie information distributions in the real world, given any information distribution in favour of, for example, Alternative A over Alternative B it should be more likely to obtain a subset that (more or less) resembles this superiority than a subset that reverses this rank-order. However, this does not say much, because the real hidden profile frequencies in different contexts could be everywhere between "in almost half of all cases" and "almost never". We recently ran simulations on this issue and—under the assumption that the distribution of information to group members follows a random process, and dependent on several variables like the number of alternatives, group size, amount of information, or average sharedness of information—we obtained average frequencies of 1–5% for the occurrence of hidden profiles, with a maximum at 23%. Hence, hidden profiles may be an exception rather than the rule, but they are not all that seldom (Schultze, Faulmüller, Schmidt-Hieber & Schulz-Hardt, 2012). Thus hidden profiles are clearly the exception rather than the rule. However, we would like to emphasise that the use of this paradigm is not motivated by (and not dependent on) the relative or absolute frequency of hidden profiles in the real world, but rather by the fact that systematic synergy in group decision making is only possible in hidden profile situations. Hence, as long

as we use groups in order to facilitate decision quality, we have to investigate hidden profiles.

Group decision making vs group problem solving

We hope that we have successfully argued why our model captures the processes that generally facilitate or impede synergy in group decision making in general. However, does it also apply outside the field of group decision making? Although we see the danger of losing focus when broadening the scope of a model too much, we think it could be, at least, fruitful to check whether the categories and the processes specified in the model can also be applied to problem solving in groups (e.g., Hoffman, 1966; Laughlin, 2011). Although the lines between group decision making and group problem solving are sometimes blurred, the crucial difference in our view is that group decision making refers to situations with fixed decision alternatives, whereas in group problem solving no pre-determined alternatives exist, and a solution to a given problem has to be constructed. Similar to group decision making, synergy in group problem solving occurs if the group cooperatively develops a solution that is superior to any of the proposals that the individual members have made prior to discussion (strong synergy) or to the average solution proposed by the individual members (weak synergy).

The question then is: How can the group ''build'' a solution that no one has thought of before individually? If we assume that the ''building blocks'' of such a synergetic new solution are unique pieces of knowledge (ideas, facts, or whatever) that the individual group members hold and that are integrated during group discussion (and we cannot think of a plausible alternative way in which this synergy should be achieved), then the essence of this situation is similar to that of a hidden profile, and the processes specified in our model could be applied.

This is not to say that we would not expect any differences. Plausibly, the group members' initial preferences might be much weaker in a problem-solving situation than in a decision-making situation, because members might be aware of the fact that final solutions in a situation without fixed alternatives are often not identical to any of the members' initial proposals. Furthermore, the higher the demonstrability (Laughlin, 1980) of an individual solution to a problem, the less the other members should rely on their own preferences. Both elements of group problem solving could reduce preference-consistency biases in group discussion and information elaboration. Nevertheless, to some extent these biases could or should still be present, and we can see no reason why the biases in favour of shared information should be reduced, because their underlying mechanisms should not be affected by the presence or absence of fixed alternatives prior to

discussion. Similarly, it is also highly plausible that discussion and processing intensity play a crucial role in group problem solving, and a fundamental group dynamic that reduces these intensities, namely the consensus-seeking tendency and the exchange of preferences, should have the same detrimental effect in group problem solving. Hence we are optimistic that the basic categorisation scheme of our model could be successfully applied to group problem solving.

CONCLUSION

Groups are often expected to yield a "quality surplus" when making decisions. As we have seen, fundamental dynamics of how groups exchange and how group members elaborate the information exchanged work against the manifestation of such synergy in groups. We hope our model helps to understand these dynamics, to develop realistic expectations about the chances and risks of group decision making, and to successfully shape conditions for high-quality decision making in groups.

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