From Fault Line to Group Fission: Understanding Membership Changes in Small Groups

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Group fissions occur when two or more members leave a parent group to either form a new group or join an existing group. This article investigates the interplay between two factors: the presence of an intragroup conflict and subgroup boundaries on the group fission process. It is hypothesized that subgroup divisions act as potential fault lines along which groups split after they experience conflict. The results of three experiments, one scenario study and two laboratory studies involving small task groups, support the group fault line hypothesis. The authors discuss the implications of these findings for theory and research on membership changes in small groups.

Keywords: *group fission; fault lines; social dilemmas; free riding; subgroup boundaries*

A key feature of any form of human social organization is its flexibility (Cartwright & Zander, 1953; Hogg & Tindale, 2001). Human groups form, transform, break up, and reform at a speed that has no parallels in the animal world. This organizational flexibility is functional in that it allows individuals to cope with pressures of group life, which presumably was a key ingredient of the survival of our ancestors in the hostile environment of the Pleistocene (Barkow, Cosmides, & Tooby, 1992).

Group transformations occur in many different forms, but arguably one of the more dramatic changes is a group fission. Fissions occur when two or more group members, in conjunction, exit their parent group to either establish a new group (the exit group) or join a different group. Examples of group fissions have been documented in numerous settings, including profit and nonprofit businesses (Dyck, 1997; Dyck & Starke, 1999), religious groups (Sani & Reicher, 1998, 2000), political parties (Sani & Reicher, 1998), nation states (Bookman, 1994), hunter-gatherer societies (Kelly, 1995), as well as in nonhuman societies of primates (Wilson, 1975).

Depending on the literature, group fissions have been referred to as schisms, factions, group exits, or breakaways. We prefer to use the term "fission" here for two reasons. First, although we appreciate that not every social psychologist might be familiar with the term, group fission is a standard term in the anthropological and animal behavior literatures to indicate the break up of an original population into two or more subgroups (cf. "fission-fusion" societies) (Wilson, 1975). Thus, for the purpose of facilitating communication between the behavioral sciences, we prefer to stick with a more generic term. Second, there are parallels between a group fission and the fission process in nuclear physics.[1] Similar to atomic fission, groups can fission through a force inside or outside the group, and when groups fission they split into several smaller fragments that can be referred to as fission "products." Furthermore, a fission often alters groups in such a way that it is impossible to recreate the old group simply by putting the new groups together (Arrow, McGrath, & Berdahl, 2000).

Group fissions are not uncommon. A survey in North America estimated that one in five businesses started as a breakaway from the parent organization (Dyck, 1997). Yet, despite the ubiquity of group fissions and their impact on group dynamics, there is surprisingly little theory and research on this phenomenon (Dyck & Starke, 1999;

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Sani & Todman, 2002). Traditional group development theories largely ignore group transformations such as fissions. For example, Tuckman's (1965) famous group development model incorporates a final group adjournment phase, but it does not recognize that several new groups might emerge at the end of a group's life cycle. Furthermore, social psychological research on membership change in groups has concentrated almost exclusively on why people leave groups as individuals (rather than as subgroups) either through voluntary exit (Moreland & Levine, 1982; Prislin & Christensen, 2005; Rusbult & Farrell, 1983; Van Vugt, Jepson, Hart, & De Cremer, 2004) or through exclusion (Ouwerkerk, Kerr, Gallucci, & Van Lange, in press; Williams, 2001). Yet, these models are less suitable for explaining group fissions for at least two reasons.

First, group fissions are more complex because they require the conjunctive efforts of a subgroup of individuals acting simultaneously. Second, a fission is more likely to transform the group culture because when a subgroup of like-minded people leave together they often take away what they have contributed to the group in terms of shared effort, norms, and values. Fissions are therefore more likely to affect the group's original identity, the very essence of what groups are about (cf. Arrow et al., 2000).[2] To illustrate, after the breakup of Yugoslavia in 1991, each of the former republics changed symbols associated with the culture of the original state, including the flag, the national anthem, and official holidays.

When does a group fission occur and how does it happen? This article provides a preliminary answer to these questions by examining the interaction between two potentially important facilitating conditions for group fission: the presence of conflict and subgroup boundaries within the original group. We hypothesize that subgroups act as group fault lines along which a group fissions after it has experienced a severe intragroup conflict. We test this fault line hypothesis in three studies: a scenario study and two laboratory experiments.

A Social Dilemma Analysis of Group Fission

One possible reason why groups undergo a change as dramatic as fission is because of the experience of a severe intragroup conflict, for example, over the provision or distribution of valuable public goods such as food, money, or status. Frequently, these problems, commonly known as social dilemmas (Komorita & Parks, 1994), pit the private interests of group members against the overarching interest of the group. It is in the group's interest to ensure that each member takes a fair share of a common resource or does a fair share of the work, yet some members might free ride on the efforts of others.

The free rider problem is regarded by many as the key problem that humans needed to solve throughout evolutionary history to reap the benefits of group life (Barkow et al., 1992; Van Vugt & Van Lange, in press).[3] Group life benefited individuals significantly, but it also posed many problems that pitted an individual's interests against the rest of the group. To the extent that groups were more effective in overcoming free rider problems, individuals profited more from their group membership. As a consequence, evolution might have shaped human social cognition and behavior to deal effectively with free riding in groups, small and large (Van Vugt & Van Lange, in press).

Group dynamics research has suggested several solutions for dealing with free riding in groups. First, group members could compensate for free riders by increasing their contributions to the group, but this can be costly (Williams & Karau, 1991). Sometimes, free riders are dealt with directly through ostracism, punishment, or exclusion from the group (Ouwerkerk et al., in press; Williams, 2001; cf. black sheep effect; Marques, Abrams, Paez, & Martinez-Taboada, 1998). Third, the temptation to free ride can be reduced by offering rewards for cooperation, promoting prosocial norms and values, and by developing trust, loyalty, and identification with the group (Kramer & Brewer, 1984; Van Vugt & Hart, 2004; Wit & Kerr, 2002). A fourth, indirect solution is to reduce the size of the group so that a large group is split into smaller units in which free riding is perhaps more easily contained (Van Lange, Van Vugt, & De Cremer, 2000). Several reasons have been suggested for why cooperation tends to be greater in smaller groups. Members of smaller groups might trust each other more, identify more with the group, and feel more accountable to their fellow group mates (cf. social loafing) (Kerr & Bruun, 1983). In addition, members of small groups might think that their contribution matters more than in large groups—even when this is objectively not true (Kerr, 1989).[4]

Although there has been a good deal of research into the relation between group size and cooperation, several questions have not yet been addressed that are relevant to group fission. First, do people actually prefer to split a larger group and move into a smaller group? Small groups do bring benefits in terms of cooperation, but they are also more vulnerable against attacks from a stubborn free rider or a rival group (Van Vugt & Van Lange, in press). Second, even if people prefer a smaller group as opposed to a larger group, how does one go about changing the group boundaries? There are many different ways to split a group, but some will be easier than others, depending, for example, on the structural and social-demographic makeup of the group.

That group fissions occur in response to problems of free riding is supported by data from two different literatures. First, management studies show that organizational fissions are nearly always precipitated by a period of intense conflict within the mother organization (Balser, 1997; Dyck, 1997). Furthermore, there is anthropological evidence from hunter-gatherer societies showing that band fissions nearly always emerge after a period of intense conflict over scarce resources such as food and mates (Chagnon, 1977; Kelly, 1995).

Together, these diverse lines of inquiry provide preliminary support for a social dilemma analysis of group fission, suggesting that this process is set in motion by a desire to deal with intragroup conflicts such as free riding. Yet, because the evidence is largely anecdotal, it is not yet clear whether free rider problems are indeed necessary or sufficient causes for the fissioning of a group. Moreover, the available research is not quite clear on how group fissions actually take place, that is, along which lines groups divide when they fission. These are important questions to address to build a model of group fission.

A Subgroup Identity Perspective on Group Fission

A complementary perspective, rooted in theories and research on group diversity and social identity, assumes that the driving force behind fissions is the presence of subgroup boundaries within the group (Moreland, Levine, & Wingert, 1996). Most groups are internally divided into subgroups (Hornsey & Hogg, 2000). For example, work teams consist of men and women, old and young, people of different ethnic backgrounds, different personalities, and attitudes. According to the subgroup identity perspective, this diversity increases the risk of member discontent and group conflict.

This perspective is theoretically embedded in self-categorization and social identity theories (Tajfel & Turner, 1986; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Following these theories, people derive their self-knowledge and self-worth, at least in part, from the groups with which they identify. Group identifications serve as a guide for the thoughts and actions of individuals (Brewer & Brown, 1998). Group members can define themselves on the level of the entire group, in which case a superordinate identity is salient, or on the level of the subgroup, in which case a subgroup identity is salient. According to the subgroup perspective, group fissions are more likely whenever a subgroup identity becomes salient, which is perceived to be in conflict with the superordinate identity (Sani & Todman, 2002).

This is supported by several lines of evidence. Research on identity processes in social dilemmas suggests that the salience of subgroup identities undermines cooperation and cohesion in the superordinate group (Kramer & Brewer, 1984; Wit & Kerr, 2002). The negative influence of subgroup formation is also echoed in research on management teams, showing that diversity in team composition increases the prevalence of conflict and turnover within teams (Jackson et al., 1991). This is true in the case of demographically and psychologically diverse groups. In terms of group efficiency, however, the impact of group diversity is less clear. Groups that contain (psychologically) similar members usually outperform groups whose members are (psychologically) diverse (Moreland et al., 1996), with the exception of creativity tasks (Jackson et al., 1991). Finally, research on schisms in political parties and religious associations has demonstrated the impact of diversity on fission (Dyck & Starke, 1999; Sani & Reicher, 1998, 2000). Based on interviews with members of the Italian Communist party, Sani and Reicher (1998) concluded that the schism that occurred in the party in 1991 could be attributed to fundamental differences in opinion between different factions regarding what the party's position should be after the fall of the Soviet Regime.

Taken together, these findings suggest that subgroup formation and conflicting subgroup identities may form the primary basis for fission. But, how can this perspective be reconciled with the idea that the basis for a fission lies in the experience of a free rider problem within groups?

Toward an Integration: The Fault Line Hypothesis

The fault line hypothesis, originally proposed by Lau and Murninghan (1998), assumes that most groups can be divided into two or more homogeneous subgroups that differ from each other on the basis of a particular set of attributes. These attributes can be demographic (gender, profession) or psychological (personality, values), and they can create imaginary dividing lines within a group that can be regarded as fault lines, much like geological faults in the earth's surface that cause earthquakes. Similar to geological faults, group fault lines determine the location where pressures are building up in the group and where it is likely to break after a force is imposed on it. Furthermore, group fault lines are often only visible if activated through force. Hence, they may remain unnoticed for long periods, unless pressure is exerted on them. Finally, group fault lines may differ in strength. Some may be so minor that, once activated, they have little impact on the group, whereas others may be so deep and strong that they cause the collapse of the group.[5]

Whether a fault line is activated depends largely on the nature of the group task and the association between task and (sub)group characteristics (cf. Oakes, 1987). For example, in a shared house containing male and female students, the gender of the housemates is a potential fault line if there is a severe conflict about cleaning arrangements in the house. Because men are generally regarded as being less clean than women, gender may become a salient dividing line along which the group may reorganize itself to cope with this conflict.

The fault line analogy can be a useful tool in developing hypotheses about the paths leading from conflict to fission. Using this comparison, we shall discuss two possible routes toward a group fission, each offering a different prediction about the role that subgroups play in the splitting process. A first possibility is that subgroup divisions merely determine along which lines the group will break after it experiences conflict, that is, they determine the location of the split. We refer to this as the weak fault line hypothesis because it assumes that conflict drives the fission, yet the subgroup divisions determine the composition of the breakaway groups. It is also plausible that subgroup divisions magnify the impact of the conflict such that groups with fault lines are, in general, more likely to breakup than are groups without. We refer to this as the strong fault line hypothesis because it assumes that the presence of subgroups makes a group inherently less stable.

To illustrate the difference between the predictions, let us look again at the example of the student house. The strong fault line hypothesis predicts that fission likelihood in the house is greater if there is a subgroup division (gender) that is associated with the nature of the conflict (cleaning arrangements). The weak fault line hypothesis predicts that the presence of gender differences does not by itself increase the chances of a fission, but if the group breaks, it will do so along gender boundaries.[6]

Research Overview

We report three studies in which we test the fault line hypothesis of group fission: a scenario study and two laboratory studies. In each study, we employed a task with a potential opportunity to free ride, thereby causing a conflict within the group. Such tasks are formally known as social dilemmas or, more specifically, as public good dilemmas (Dawes, 1980). In the scenario study, we manipulated the presence (or absence) of conflict within the context of living in shared student accommodation. In the laboratory studies, we employed a standard public-good dilemma task to create a group conflict (see Van Vugt & De Cremer, 1999). Furthermore, we manipulated the presence or absence of subgroup boundaries within the group. Participants either had much in common with all members of their group (no-subgroup condition) or just with some members (subgroup condition). We then asked participants two key questions: "Do you want this group to split?" and "Which group members do you choose to establish a new group with?"

SCENARIO STUDY

In this study, we examined group fission through a scenario on living arrangements in student accommodation. We used cleaning arrangements and noise levels as the conflict domain. This was informed by results of a pilot study among 12 postgraduates, which revealed that 91.7% would choose not to live with undergraduates, mentioning conflict about cleaning (76%) and noise (67%) as primary sources of contention. Hence, the sample consisted of postgraduates only, and the postgraduate-undergraduate distinction was used to create the subgroup categories.

According to the strong fault line hypothesis, a fission would be more likely in the presence of both a conflict and clearly identifiable subgroups, that is, a mixture of undergraduates and postgraduates, as opposed to all postgraduates. Thus, we expect an interaction between the conflict and division manipulations. The weak fault line hypothesis states that conflict produces fission, but the subgroup division determines along which lines the group splits; thus, we would expect a main effect of conflict on the fission likelihood and a main effect of division on the exit group composition.

Method

Participants and design. In total, 92 postgraduates at the University of Southampton, 35 men and 57 women, participated in this study. The mean age of participants was 26.39 years (SD = 5.91). Participants were randomly assigned to one of four conditions according to a 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) between-participants factorial design. There were between 22 and 24 participants per cell.

Scenario and questionnaire. First, participants received some background information, which included the division manipulation. In the no-subgroup condition, participants read, "You are a postgraduate living in a student house with five other people: Andrea, Chris, Sam, Jamie, and Nicky—all of whom are *postgraduates*, like yourself." In the subgroup condition, participants read, "You are a postgraduate living in a student house with five other people: Andrea, Chris, Sam, Jamie, and Nicky. Whilst Andrea and Chris are *postgraduates*, like yourself, Sam, Jamie, and Nicky are *undergraduates*." This was followed by the conflict manipulation. In the no-conflict condition, participants read,

> Everyone in the house gets along well with each other. You all do a fair share of the housework and are considerate of each other's needs by being quiet when you go out in the evening and come back late. Generally, you are all quite satisfied with the current living arrangements as they are.

In contrast, in the conflict condition, participants read,

> Recently, there have been arguments in the house. Certain housemates are not doing their fair share of the housework and are going out some evenings and coming back in the early hours and making a lot of noise. Generally, you are not very satisfied with the current living arrangements as they are.

Participants in all conditions were then informed,

> It is approaching the end of the academic year and the tenancy agreement on your student house is due to end next month. The landlord has contacted you to let you know that he is happy for you to extend the warranty if you all want to. You have been looking on the University notice board and have seen a house advertised, which can accommodate three people.

Each participant then answered the primary group fission question: "What would you like to do, stay in the house (0) or move out with some others (1)?" Subsequently, participants were told that a fission was imminent and were asked to indicate which two housemates they would like to form an exit group with.

Procedure. Participants received the scenario and questionnaire per e-mail after responding to an advertisement asking for volunteers to partake in a study on "living in shared student accommodation." They were instructed to read carefully through the scenario before answering the questionnaire. On completion, participants were debriefed and thanked for their help.

Results and Summary

Group fission. To analyze the data, we conducted a 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) logistic regression on the fission choice. In a preliminary analysis, we included gender of participants as a factor in the design, but because there was no gender effect in this study, $\chi^2(1, N = 92) < 1$, or indeed in any of the other studies, we collapsed the design across gender.

Analysis showed that more people wanted to split in the conflict (88.6%) than in the no-conflict condition (22.9%), χ^2 $(1, N = 92) = 44.24$, $p < .001$. There was no effect of division, $\chi^2(1, N = 92) = .02$, $p = .88$, nor an interaction, $\chi^2(1, N = 92) = 1.92$, $p = .17$, thus, no support for the strong fault line hypothesis. The presence of subgroups in the household did not affect the likelihood of a fission.[7]

Composition of the exit group. We analyzed the exit group composition preferences in a 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) ANOVA. Recall that Andrea and Chris were mentioned in both the subgroup and no-subgroup conditions as sharing the same graduate status as the focal participant. Hence, we recoded each participant's combination of choices for housemates, such that they received a score of 1 if they chose these two names, a score of 0 if they chose one of these names, and a –1 score if they chose neither of these names.

The weak fault line hypothesis predicts a main effect of division, which was significant, $F(1, 84) = 60.85$, $p < .001$; 80.0% of participants in the subgroup condition chose to form a group with Andrea and Chris (fellow postgraduates) compared to 14.0% in the no-subgroup condition, thus demonstrating in the subgroup condition a clear preference for dividing the group along subgroup boundaries. There was no conflict main effect, $F(1, 84) = .04$, $p = .84$, nor an interaction, $F(1, 84) = .08$, $p = .78$.

These results provide support for the weak fault line hypothesis. Subgroup division did not exacerbate the tendency for groups to fission when they experienced a conflict, even though we established in the pilot that the subgroup categories (graduate status) were believed to be related to the nature of the conflict (cleaning). Furthermore, results showed that prior subgroup divisions strongly affected the composition of the exit groups.

LABORATORY STUDIES: EXPERIMENT 1

The evidence so far is based on the results of a role-playing study. However, this methodology is open to social desirability and self-presentational tendencies (Greenwood, 1983). Such biases may have played a role in our first experiment because the postgraduates may not have wanted to appear prejudiced against undergraduates. Furthermore, there were no tangible outcomes associated with the scenario because our participants did not experience the house conflict themselves, although they would have been all too familiar with these problems. Hence, the fission may not have had a direct effect on participants' outcomes.

To deal with these criticisms, we designed an experiment to explore group fission and its possible determinants in six-person task groups in the laboratory. The task involved a step-level public good dilemma, which resembles a variety of free rider problems in the real world, including tax paying and contributing to community schemes (Van Vugt, Snyder, Tyler, & Biel, 2000). In this task, group members can decide whether to invest money in a collective good for the group. This good is only provided if a minimum number of members make an investment. Moreover, if the group fails to provide the good, each contributor loses their endowment.

In this task, free rider conflict was induced by providing bogus feedback about how (un)successful the group had been in providing the good. Furthermore, we manipulated the subgroup divisions using an attitude similarity questionnaire—participants were either led to believe they shared similarities with all members of their group or with just two other members. At the end of six trials, participants were given the option to stay in the six-person group or split into three-person groups for the remainder of the task.

The strong fault line hypothesis predicts an interaction between conflict and division on the preference to work in a smaller group. Thus, when free riders are present in the group, then its members will have a stronger preference for splitting, especially when the group consists of a subgroup of members that are similar to them as well as a subgroup of dissimilar others. The weak fault line hypothesis predicts two main effects: the free rider conflict facilitates the fission preference but subgroup division determines along which lines the group splits.

This experiment also enabled us to search for mechanisms underlying the emergence of group fission. Based on previous research (Kerr, 1989; Komorita & Parks, 1994), we hypothesized that fissions may occur due to a fear of free riders. Hence, we expected to find fission preferences to be associated with lower levels of trust in other group members.

Method

PARTICIPANTS AND DESIGN

In total, 104 students at the University of Southampton, 17 men and 87 women, participated in this study. The mean age of participants was 20.02 years ($SD = 2.43$). Participants were randomly assigned to one of four experimental conditions according to a 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) between-participants factorial design. There were between 25 and 27 participants per cell.

PROCEDURE

Participants volunteered to take part in a study on "group interactions and group performance." After arriving at the laboratory in groups of six, participants were seated in individual cubicles, each containing a computer. All instructions were presented on the screen.

Manipulation of subgroups. Participants were given a number to identify themselves (always number 18) and the other group members (16 to 21).

They then completed a similarity questionnaire, indicating their tastes in music, films, TV programs, food, and their views on environmental issues and relationships, to find out to which members of the group they were alike. The feedback they received following the questionnaire was bogus feedback to incorporate the subgroup manipulation; in the no-subgroup condition, participants gave similar answers to all other members, whereas in the subgroup condition, their answers were similar to participants 16 and 21 and dissimilar to the rest.

This manipulation was followed by six group-identification questions used to determine the salience of their group (vs. subgroup) identity (for a similar scale, see Brown, Condor, Mathews, Wade, & Williams, 1986). The questions were measured on a rating scale (1 = *not at all*, 7 = *very much so*) asking, "To what extent do you fit in well with this group/identify with other group members/have a lot in common with other group members in general/have a lot in common with other group members in terms of specific opinions and attitudes," "Would you say you had a lot in common with the other members of the group," and "To what extent do you feel that your group is cohesive?" ($\alpha = .89$).

Experimental task. Participants received standard instructions for a step-level public good task and were then told,

> Before each session, you will get an endowment of £3. Per session, you will have the opportunity to invest these £3 in your group or keep the £3 to yourself (you must either invest all or nothing!). If enough people in your group invest, each of you will earn a £5 bonus for that session. At least 4 out of 6 members need to invest their endowment in the group in order to earn the bonus. If fewer than 4 individuals invest, the bonus is not provided and each of the investors will lose their endowment, while non-investors keep it, in that session.

Several practice sessions followed to check their understanding of the pay-offs.

Subsequently, the task began. In each session, participants were asked, "Do you wish to invest your endowment in the group?" (0 = no, 1 = yes). After each session, feedback was provided detailing whether the group had achieved the bonus.

Manipulation of free rider conflict. The feedback was manipulated such that the group achieved the bonus in two of six sessions (conflict condition) or in four of six sessions (no-conflict condition).

After the sixth session, participants received a message from the experimenter to tell them that they would soon be given an opportunity to change the group structure. If they wanted, they could split the group in two so that each of them would join a smaller group of three members to continue the task. Each participant then answered the group-fission question: "What would you like to do? (0 = stay in existing group, 1 = split into smaller groups). Subsequently, participants were told that the split was imminent and were asked to choose two members with which to form an exit group.

To test the free rider hypothesis, we asked participants to reveal the amount of trust they had in fellow group members. For each member, participants had to guess the number of times they had contributed their endowment (0-6 times).

Finally, participants were asked three questions to ensure that they understood our manipulations. They reported how many times their group had achieved the bonus (0-6) and with how many group members they shared similarities following the attitude similarity test (1-5). Participants answered these questions correctly. Finally, participants were asked whether they were satisfied with their group's performance during the task (1 = *not at all*, 7 = *very much so*).

Participants were then debriefed, thanked, and received a lump sum of £5. No suspicions were raised regarding the experimental manipulations.

Results and Summary

MANIPULATION CHECKS

A two-way ANOVA on the manipulation question, "How satisfied were you with the performance of your group?" (1 = *not at all*, 7 = *very much so*) showed that participants in the conflict condition (M = 2.62, SD = 1.03) were less satisfied with the group's performance than were those in the no-conflict condition (M = 4.94, SD = 1.11), $F(1, 100) = 122.59$, $p < .001$. There was no effect of division, $F(1, 100) = .20$, $p = .66$, and no interaction, $F(1, 100) = 1.60$, $p = .24$.

Furthermore, an average score across the group-identification questions was calculated. This identification score was then subjected to a 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) ANOVA to check the effectiveness of the subgroup manipulation. This revealed a main effect of division, $F(1, 100) = 9.94$, $p = .002$, suggesting that participants in the subgroup condition identified less with the entire group (M = 3.78, SD = .85) than with those in the no-subgroup condition (M = 4.33, SD = .92). The means in the subgroup and no-subgroup condition differed significantly (albeit marginally in the subgroup condition) from the scale midpoint, respectively, $t(50) = -1.84$, $p = .07$ and $t(52) = 2.62$, $p < .05$.

There was no effect of conflict, $F(1, 100) = .33$, $p = .57$, nor an interaction, $F(1, 100) = .001$, $p = .97$. These results show our manipulations were successful.

GROUP FISSION

To analyze the data, we conducted a 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) logistic regression on the fission choice. This revealed a main effect of free rider conflict, $\chi^2(1, N = 104) = 23.50$, $p < .001$. More participants wanted to split in the conflict (51.9%) than in the no-conflict condition (9.6%). There was no division effect, $\chi^2 < 1$, nor an interaction, $\chi^2(1, N = 104) = 1.43$, $p = .23$.[8]

COOPERATION

To examine if the fission choice was influenced by the amount of cooperation during the task, we calculated how often participants contributed over the trials. This sum (0 = *never invest*, 6 = *always invest*) was entered into an ANOVA along with the fission choice as an independent variable. Results showed that "stayers" versus "splitters" did not differ in the number of times they invested across trials, $F(1, 102) = .51$, $p = .48$, suggesting that it was not just the cooperators who wanted to fission.

An ANOVA including the complete factorial design revealed a main effect of division, $F(1, 100) = 4.48$, $p < .05$. Consistent with other research (Kramer & Brewer, 1984; Wit & Kerr, 2002), the rate of group contributions was higher in the no-subgroup condition (M = .73, SD = .25) than in the subgroup condition (M = .57, SD = .26). There was no conflict effect, $F(1, 100) < 1$, nor an interaction, $F(1, 100) < 1$.

COMPOSITION OF EXIT GROUPS

Participants' preferences for breakaway members were analyzed using a 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) logistic regression. Recall that participants 16 and 21 were similar to the focal participant in the subgroup and no-subgroup conditions. Therefore, participants' choices of breakaway members were recoded such that they received a score of 1 if they chose these two members, a score of 0 if they picked a similar member and a dissimilar member, and a score of –1 if they selected two dissimilar members (participants 17, 19, 20).

The division effect was significant, $\chi^2(2, N = 104) = 71.58$, $p < .001$. As predicted by the weak fault line hypothesis, participants 16 and 21 were elected by 84.3% of participants in the subgroup condition and 7.5% in the no-subgroup condition, suggesting a clear preference for dividing the group along subgroup lines. There was no conflict effect, $\chi^2(1, N = 104) = 1.39$, $p = .50$, nor an interaction, $\chi^2(2, N = 104) = 1.08$, $p = .58$.

TRUST IN OTHER GROUP MEMBERS

Participants were asked, "During the contribution sessions, how many times do you think participant [16, 17, 19, 20 and 21] contributed their endowment?" A composite trust index was calculated and entered into a correlation with the fission preference to enable us to test our free rider hypothesis. This revealed a negative correlation between trust and fission preference, $r = -.26$, $p = .01$, supporting a possible link between fission and fear of free riding.

A 2 (free rider conflict: conflict, no-conflict) × 2 (division: subgroup, no-subgroup) MANOVA then analyzed participants' responses to these trust questions, the results of which revealed a main effect of conflict, $F(5, 96) = 5.05$, $p < .001$, and of division, $F(5, 96) = 5.23$, $p < .001$, but no interaction, $F(5, 96) = 1.15$, $p = .34$.

Further univariate analyses revealed that participants in the no-conflict condition expected fellow group members to contribute more than those in the conflict condition. Significant differences in trust were obtained for each group member: participant 16, $F(1, 100) = 14.80$, $p < .001$; participant 17, $F(1, 100) = 14.79$, $p < .001$; participant 19, $F(1, 100) = 17.88$, $p < .001$; participant 20, $F(1, 100) = 5.77$, $p = .02$; participant 21, $F(1, 100) = 15.33$, $p < .001$.

More importantly, the univariate analyses associated with the division effect revealed that in the subgroup condition, there was greater trust in participants 16 and 21 (the similar members). Participant 16 was believed to have contributed more in the subgroup condition ($M = 3.50$, $SD = 1.13$) than in the no-subgroup condition ($M = 2.92$, $SD = 1.05$), $F(1, 100) = 8.33$, $p = .005$, as was participant 21 ($M = 3.60$ vs. 3.29, $SD = 1.35$ and 1.09), although this failed to reach statistical significance, $F(1, 100) = 1.86$, $p = .18$.

These results support the weak fault line hypothesis. Subgroup division did not exacerbate the likelihood of a fission, although there was generally less cooperation and less trust in each other when subgroups were present. The subgroup divisions affected the exit group composition by establishing a clear preference for in-subgroup members over out-subgroup members.

EXPERIMENT 2

The results of the experiments as yet have provided no support for the strong fault line hypothesis. A critic might argue, however, that this hypothesis has not received a fair trial. According to Lau and Murninghan (1998), the activation of particular fault lines depends on the contents and outcomes of the group task. Although participants previously knew the group outcomes, they were not able to tell which group members were responsible for their poor group performance. Hence, they made inferences based on the information available to them, that is, with whom they shared (dis)similarities and therefore trusted more (less).

What would happen if we gave participants explicit feedback about who the cooperators and free riders were? According to the strong fault line hypothesis, if those cooperators were members of their in-subgroup (and the free riders were members of the out-subgroup), this would be more likely to lead to a fission than if there were no subgroup divisions.

Hence, we redesigned the second experiment to incorporate bogus feedback about the investment decisions of each group member. Thus, participants were first informed about the presence/absence of subgroups within their group. Second, they received feedback in the task regarding whether the group had been (un)successful in obtaining the bonus. Because the conflict manipulation had revealed such reliable effects previously, we decided to only create a condition where the groups failed in the majority of sessions (the original conflict condition). In addition, participants received feedback about the decisions of each group member.

The strong fault line hypothesis predicts a main effect of division on the fission choice, whereas the weak fault line hypothesis predicts division only to influence the formation of the exit groups.

Method

PARTICIPANTS AND DESIGN

Forty-six psychology undergraduates at the University of Southampton, 15 men and 31 women, partook in a study on group interactions, for which they received credits as part of their course requirement. The mean age of participants was 21.46 years ($SD = 3.11$). Participants were randomly assigned to one of two conditions, the subgroup or no-subgroup condition, with 23 participants per cell.

PROCEDURE

The procedure and instructions were similar to those in Experiment 1, with a few notable exceptions.

First, the group members each received an identification letter (A to E)—the participant was always member C (after a pilot revealed that people memorized letters better than numbers).

Participants completed the similarity questionnaire as per Experiment 1. The bogus feedback was provided; in the subgroup condition, members A and F were reported to be similar and B, D, and E dissimilar to the participant.

This was followed by the group-identification questions, also used in Experiment 1 ($\alpha = .87$).

The investment task followed. This still comprised six contribution sessions but the feedback they received after each session was altered to include information about the investment choices of individual members. This information was such that members A and F cooperated in four of six sessions and members B, D, and E defected in four six sessions.

After completing the six sessions, participants indicated their fission choice and selected two members with which to form a breakaway group.

Unlike the previous study, participants then completed three contribution sessions after the fission had taken place to give an indication of whether cooperation levels would increase following the split. They were informed,

> For the purpose of the second round, you are working with the two members you selected to be in a smaller group with. At least two of the three members need to contribute in order to get the bonus.

The same manipulation checks that were employed in Experiment 1 were then asked before participants were debriefed and thanked for their participation. No suspicions were raised regarding the nature of the manipulations.

Results and Summary

MANIPULATION CHECKS

Analysis of the group-feedback question ("How satisfied were you with the performance of your group?" 1 = *not at all*, 7 = *very much so*) confirmed that participants were dissatisfied with their group performance (M = 2.83, SD = 1.04). This mean differed from the scale midpoint, $t(45) = -7.66$, $p < .001$.

Furthermore, analysis of the group-identification score was performed to check the effectiveness of the subgroup manipulation. This revealed an effect of division, $F(1, 44) = 4.27$, $p < .05$; participants in the subgroup condition identified less with the entire group (M = 3.77, SD = .91) than did those in the no-subgroup condition (M = 4.41, SD = 1.17). Neither of these means differed significantly from the midpoint of the scale, $t(22) = -1.22$, $p = .24$, and $t(22) = 1.67$, $p = .11$, respectively. Thus, our manipulations were successful.

GROUP FISSION

The group fission analysis was conducted using a logistic regression on the fission choice. The results failed to find a main effect of division, χ^2 (1, N = 46) = .11, $p = .74$. Thus, it appears that subgroup division does not determine whether group fission will ensue even when the actions of out-subgroup members clearly cause the free rider conflict.[9]

COOPERATION

To examine if the fission choice was influenced by the amount of cooperation during the task, we calculated how often participants contributed throughout the six trials. This sum (0 = *never invest*, 6 = *always invest*) was entered into an ANOVA along with the fission choice. As in Experiment 2, results showed that "stayers" versus "splitters" did not differ in the number of times they invested across trials, $F(1, 44) = .77$, $p = .38$.

COMPOSITION OF THE EXIT GROUPS

To examine whether the presence of subgroup boundaries determines the exit group composition, we analyzed the preferences for breakaway members using a logistic regression whereby the dependent variable was the combined choice for two individuals. The choice of breakaway members was recoded in the same manner as the previous studies. As predicted, a main effect of division was found, $\chi^2(2, N = 46) = 11.09$, $p < .001$. In the subgroup condition, considerably more people chose participants A and F (69.6%) than in the no-subgroup condition (21.7%).

EFFECTS OF FISSION ON GROUP PERFORMANCE

Participants undertook three extra contribution sessions within their smaller groups to investigate the effects of fission on cooperation. The average number of times participants invested before and after the fission was calculated. A repeated-measures ANOVA revealed a significant increase in investments after the fission, $F(1, 44) = 23.71$, $p < .001$. Participants contributed more often in the smaller groups (M = .85, SD = .29) than they did in the original group (M = .63, SD = .28). There was no effect of division, $F(1, 44) = 1.18$, $p = .28$, and no Investment × Division interaction, $F(1, 44) = 1.53$, $p = .22$.

These results provide support for the weak fault line hypothesis by showing that subgroup divisions determine the composition of groups after a fission but not the likelihood of a fission, even though the subgroup division was clearly associated with the nature of the conflict. Finally, fission improved group performance by increasing the rate of cooperation among group members.

DISCUSSION

Small group researchers have recently developed an interest in the dynamical processes underlying group performance and decision making (Arrow et al., 2000; Vallacher, Read, & Nowak, 2002). These studies on group fission reflect this interest. Our studies consider fission as a functional solution to the free rider problem in groups, which undermines their performance and cohesion. Our studies also reveal that fissions do not occur randomly within a group but occur along fault lines, the dividing lines between subgroups.

Strong or Weak Fault Lines?

In three studies, we tested two alternative, yet not entirely incompatible, versions of the fault line hypothesis. According to the strong fault line hypothesis, the presence of clearly distinguishable subgroups increases the likelihood of fission in the face of conflict. However, we found no support for this prediction. Instead, our results showed that subgroup divisions merely determine where groups split after they experience conflicts, thus supporting the weak fault line hypothesis.

Why do fault lines play a role in group fission? One explanation is that people bond more easily with individuals who have similar values (Byrne, 1971). Thus, when similarity is made salient on a particular attribute, people use this as a heuristic for partitioning the group. This follows from theories of social identity (Tajfel & Turner, 1986) and self-categorization (Turner et al., 1987), which suggest that subgroup formation changes members' self-identities from the superordinate level to the subgroup level. Once a subgroup identity becomes salient, people become more attracted to their subgroup than to the group as a whole and view in-subgroup members more favorably than out-subgroup members (Kramer & Brewer, 1984; Wit & Kerr, 2002). In support, our findings revealed that in the subgroup conditions, participants identified less with the overall group.

Furthermore, the salience of subgroup membership may be used as a cue for assigning trust to others. In Experiment 1, we found that in the subgroup conditions, participants anticipated greater cooperation from in-subgroup members than out-subgroup members. In social dilemmas, participants should only cooperate if they expect their efforts to be reciprocated (Trivers, 1971). Yet, without a history of interactions, it is impossible to determine who can be trusted. People often rely on (fallible) heuristics to estimate the trustworthiness of others. The experience of a common group membership may be one of the reciprocity heuristics that individuals apply (Gaertner & Insko, 2000; Van Vugt, Schaller, & Park, 2005). As Brewer (1981) stated, shared group membership may function as a "rule for defining the boundaries of low-risk interpersonal trust that bypasses the need for personal knowledge and the costs of negotiating reciprocity with others" (p. 356).

Of interest, there was no evidence that subgroup formation exacerbated the likelihood of a fission (strong fault line hypothesis). One explanation is that the subgroup categories in our studies were not meaningful to participants. However, we can effectively rule this out based on the manipulation checks, which showed that in the subgroup conditions, people identified less with the overall group and were more suspicious of members of the out-subgroup. It may be, however, that these fault lines were simply not deep enough. Lau and Murninghan (1998) discuss the possibility of fault lines being caused by two or more overlapping subgroup divisions, for example, a student house containing subgroups of three female psychology undergraduates and three male economics graduates. Perhaps in such settings, the strong fault line hypothesis is more likely to gain support. Future research should address this possibility.

Another possibility, which we also can eliminate, is that participants believed there was no connection between the cause of conflict and the subgroup division. The feedback in Experiment 2 was quite unambiguous: In the subgroup condition, the free riders all belonged to the out-subgroup. Thus, so far, our findings suggest that subgroup divisions in the original group merely play a role in determining the outcome of the fission process (the weak fault line hypothesis). Future research is needed to study the conditions under which subgroup divisions may act as catalysts for change (the strong fault line hypothesis).

Free Rider Conflict and Group Fission

Our findings suggest that one of the causes behind a group fission is the need for controlling free riding. In our laboratory experiments, group members were more likely to opt for a fission if there were free riders in their group. Members of closed groups would have to put up with free riders, perhaps even compensating for their lack of effort (Williams & Karau, 1991). Yet when people are not locked in their group, they sometimes respond to free riding by breaking away from the group (Van Vugt & Hart, 2004). These results are generally in line with social exchange theory (Thibaut & Kelley, 1959), which assumes that when the costs of group membership outweigh the benefits, a change in the status quo becomes inevitable (Samuelson, 1993). Of interest, our findings show that a fission was preferred by both cooperators and noncooperators—there was no correlation between fission preference and group contributions. This would indicate that people who are reluctant to cooperate in a larger group might start to cooperate more once a group has split.

Consistent with this argument, we found that once the fission took place, the overall cooperation levels in the breakaway groups increased. This suggests that a fission is indeed an effective strategy for managing social dilemmas. If groups become too large to effectively control free riders, a group fission might be an adaptive response, especially if there are fault lines within the group. An alternative explanation that we must consider is that people contributed more in the breakaway groups because they felt more identifiable, having received feedback about what each member previously contributed (Williams, Harkins, & Latane, 1981). Future research should compare cooperation levels in groups before and after a fission under conditions of anonymity or identifiability.

Strength, Limitations, and Implications of Research

We should note some limitations and a potential strength of our research. A first limitation concerns our main dependent measure. In our studies, group members had to choose between staying together as a group or splitting. This begs the question whether participants would have preferred a different kind of structural solution. In subsequent, yet unpublished, research we offer participants a range of structural solutions to deal with the free rider problem (including individual exit, fission, appointing a leader, sanctions). So far, results suggest that a group fission is preferred above an individual exit and appointing a group leader (Hart, 2005). This may not be too surprising because a fission primarily changes the group size while leaving intact the decisional freedom of individual members (Samuelson, 1993).

Another limitation pertains to the experimental nature of our data. The external validity of our findings would be enhanced by studying fissions in real-world groups. On one hand, we expect that having a shared group history decreases the likelihood of a fission because members of existing groups might be less tempted to free ride out of a concern with the group welfare or the fear of retribution. On the other hand, because subgroup loyalties are likely to be much stronger in the real world, we might expect larger groups to fission at a much faster rate than in the laboratory.

A third limitation refers to the generalizability of our results, namely, our focus on small task groups rather than larger opinion groups. Work groups exist to complete certain projects, which they can achieve if they solve the free rider problem (Arrow et al., 2000; Komorita & Parks, 1994). In opinion groups, such as political parties or church groups, free riding is arguably a matter of less concern. We should expect fissions within these organizations to occur primarily because of conflicts about key opinions that are dividing the group (e.g., the ordainment of women priests in the Church of England) (Sani & Reicher, 2000). But, insofar as there are subgroups present within these opinion groups, whose boundaries correspond to those of the opinion conflict, we may find that group fault lines act in the same way as they did in our research, thus splitting the community along preexisting subgroup boundaries. Thus, we acknowledge that the free rider problem is just one reason why a fission occurs and that there are many other reasons, including opinion conflicts and status struggles, that may contribute to a fission, which need to be investigated in future research. Depending on the nature and severity of the conflict, weak fault lines may become strong fault lines, thus exacerbating the likelihood of fission.

A potential strength of our research is the focus on group fission as a specific example of a group transformation. Group development theories (Tuckman, 1965; Worchel, 1996) generally ignore such transformation processes. Tuckman's (1965) model of group development includes five phases (forming, storming, norming, performing, and adjourning) but does not recognize the possibility that groups can transform into new systems at the end of their life cycle. Instead of ending at a natural endpoint, some groups may undergo a radical transformation, such that group members may perceive it as a new group even though membership with the old group may be overlapping.

In developing future research on group fission, it will be necessary to study different types of group fission. We narrowly focused here on the creation of two entirely new groups, yet it is also possible that a subgroup of members may leave their group to join an existing group. How this affects the fission process remains to be seen. On one hand, the presence of alternative groups might make it easier to collectively exit the group (Moreland & Levine, 1982). On the other hand, attractive alternatives may decrease the likelihood of a fission because individuals can pursue their goals through individual efforts rather than a subgroup effort.

Future work on group fission should also provide a more exhaustive account of the range of risk factors and protective factors for group fission. This knowledge allows groups to structure themselves in such a way that fissions become less likely, thus preventing the emotional and financial damage that a fission can cause. For example, group fissions might be activated by newcomers to the group. Insofar as these newcomers affect group culture and group identity, they may create new fault lines within the group that makes a fission more likely. A related factor is group size: Larger groups are more likely to fission than smaller groups, first, because of the presence of free riders (Komorita & Parks, 1994), and second, because of the increased likelihood of subgroup identities in larger groups (Hornsey & Hogg, 2000).

What about subgroup sizes? When subgroups are of equal size, as in our studies, there is a balance of power and group members may perceive a fission less necessary than when one of the subgroups dominates the other, which may deepen the fault lines between the factions (cf. Prislin, Limbert, & Bauer, 2000). Internal and external group factors could also inhibit the activation of fault lines leading to fission. For example, an abundance of group resources may decrease the urgency to tackle free riding. Finally, the proximity of a strong, rival group may undermine a fission because the perception of this common threat could make subgroup divisions less salient (Van Vugt, & Hart, 2004; Wit & Kerr, 2002).

Conclusions

In this article, borrowing from nuclear physics and geology, we introduced the metaphorical concepts of group fissions and group fault lines to the study of membership dynamics and transformations in small social dilemma groups. Using a social dilemma paradigm to explore these phenomena, we found that group fissions—the departure of two or more members from an original group—are initiated by a free rider conflict and that group fault lines—salient subgroup divisions within the original groups—facilitate the fission by determining the composition of the breakaway groups. Further research into the underlying causes and consequences of group fissions as one particular type of group transformation is needed to enhance our knowledge about the flexibility of human social organization.

NOTES

1. We appreciate that any metaphor has its limitations. Nevertheless, drawing parallels between the social and physical world can sometimes be illuminating.
2. Granted, individual exits also can affect group culture in important ways, particularly when a high-status member, such as an expert or leader, decides to leave the group.
3. In the group literature, free riding is sometimes referred to as social loafing (Williams & Karau, 1991). There is no real difference between the two phenomena except perhaps that social loafing specifically describes situations in which group cooperation breaks down because of identifiability problems (Kerr & Bruun, 1983). Because noncooperation occurs for many different reasons, we prefer to call it free riding here.
4. Of course, smaller groups are not always more effective than larger groups. Indeed, larger groups will outperform smaller groups on most additive and compensatory tasks. Yet, when the costs of free riding become larger than the benefits of group size then a fission is a likely solution.
5. Again, we acknowledge that there are many differences between group and geographical fault lines.
6. The strong and weak versions of the fault line hypothesis are not entirely incompatible. Both hypotheses predict that groups will split along the dividing lines created by subgroups. Unlike the weak fault line hypothesis, however, the strong fault line hypothesis also predicts that the presence of subgroups is a potential cause of group fission.
7. The fission percentages in the four conditions were no-conflict, no-subgroup (20.8%); no-conflict, subgroup (25%); conflict, no-subgroup (90.9%); and conflict, subgroup (86.4%).
8. The fission percentages in the four conditions were no-conflict, no-subgroup (3.7%); no-conflict, subgroup (16%); conflict, no-subgroup (50%); and conflict, subgroup (53.8%).
9. The fission percentages in the two conditions were no-subgroup (69.6%) and subgroup (73.9%).

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