Heterogeneity in Social Dilemmas:
The Case of Social Support

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Heterogeneous Actors in Support Relations

1.1 Social Support between Heterogeneous Actors by Way of Example

Ms. Morgenstern and Ms. Neumann are neighbors. Both women work part time. From time to time, they help each other by taking care of each other's children while the other is working. Both women are stand-by nurses in a hospital. Ms. Neumann gets a higher bonus than Ms. Morgenstern, because Ms. Neumann works in the intensive care unit. Thus, the women are equal in all respect except for the *benefits* that they obtain from receiving support, i.e., from receiving help with the care of their children and consequently being able to work. Does heterogeneity in the benefits stimulate or hinder mutual support between Ms. Morgenstern and Ms. Neumann, compared to a situation in which they obtain an equal bonus?

Let us develop the example one step further. Ms. Morgenstern's child is twelve years old, whereas Ms. Neumann's child is two. The two year old child usually needs more attention than the twelve year old. As a consequence, Ms. Morgenstern cannot do as much housework while watching Ms. Neumann's two year old child. Therefore, it is more *costly* for Ms. Morgenstern to baby-sit for Ms. Neumann than the other way around. Ms. Morgenstern thus benefits less from receiving support, plus the costs of baby-sitting are higher for her. How does the situation change if we assume that Ms. Morgenstern's child is the younger one, so that providing support is more costly for Ms. Neumann? In this case, both Ms. Morgenstern's benefits from receiving support and her costs of providing support are higher. In which of these situations is mutual support more likely?

We could go even further and assume that Ms. Morgenstern works in a department that is understaffed and therefore she is called in more often by the hospital than Ms. Neumann. Thus, Ms. Morgenstern is more often in *need of support* than Ms. Neumann. In this case, the women differ with regard to their benefits from receiving support, their costs of providing support, and their likelihood of needing support. Is support in this situation more or less likely than in any of the situations described above?

The example above describes a support relation between two actors, Ms. Morgenstern and Ms. Neumann. Following social support theorists, such as Blau (1968) and Homans (1961), we assume that the choice of providing social support is based on *benefits* from receiving support and *costs* of providing support. The question whether support will be provided is only relevant if an actor is in need of support. A support relation therefore also depends on the *likelihood of needing* support. Typically, social support occurs in the context of durable relationships (Emerson 1976, Kollock 1998), as elaborated in the example of the neighbor women. These women might differ with respect to individual properties such as the costs of providing support, the benefits from receiving support, and the likelihood of needing support. If the actors differ with respect to at least one of these individual properties, the actors are *heterogeneous*. If they differ in none of the properties they are *homogeneous*.

In this study, we compare social support between homogeneous actors with social support between actors who are heterogeneous with respect to *one* individual property. We compare, for instance, Ms. Morgenstern having higher support costs than Ms. Neumann with Ms. Morgenstern and Ms. Neumann having equal support costs – assuming they are alike with regard to all other individual properties. We furthermore compare actors who are heterogeneous regarding *one* individual property with actors who are heterogeneous regarding *several* individual properties. In the first support relation, Ms. Morgenstern has higher benefits than Ms. Neumann, but they are alike with regard to all other individual properties. In the second support relation, Ms. Neumann's costs of providing support are additionally higher than Ms. Morgenstern's. Is social support more likely in the first or in the second relation? Moreover, we study whether heterogeneity in one individual property 'interacts' with heterogeneity in another individual property regarding their effects on social support. For example, does heterogeneity affect social support differently if Ms. Morgenstern has the higher costs of providing support and Ms. Neumann is more often in need of support than if Ms. Morgenstern has the higher support costs, but Ms. Neumann needs support less often? Finally, we study different *degrees* of heterogeneity in one or several individual properties. We do this by asking questions such as whether mutual support is more or less likely the *more heterogeneous*, for example, the costs of providing support are between Ms. Neumann and Ms. Morgenstern. This study does not only compare homogeneity with heterogeneity; it also compares heterogeneity in different individual properties with each other, as well as different degrees of heterogeneity, in one or several individual properties. Most of the literature on social support claims that heterogeneity hampers social support. This claim is typically based on a comparison of homogeneity with heterogeneity in *one* individual property. However, we expect that heterogeneity in one individual property affects mutual support differently than what heterogeneity in several individual properties does, since we expect heterogeneity in several individual properties to interact. Therefore, the claim that heterogeneity hampers social support might not apply in general.

Throughout the book we are interested in the *general level* of social support ('size of the support pie'). In line with the rational choice approach, applied to interdependent behavior, we assume that actors' supportive behavior depends on their own individual properties *and* on those of their partner. The question is whether the general level of support provided by both actors is higher under homogeneity than under (different kinds of) heterogeneity. In this sense, we focus on social support at the dyadic level, rather than at the individual level. In order to study in what relation the general level of mutual support is higher, we compare, e.g., Ms. Morgenstern having higher costs and lower benefits than Ms. Neumann with Ms. Morgenstern having higher costs than Ms. Neumann, but equal benefits. Trying to account for findings in early chapters of this book, we later shift our attention to the 'distribution of the support pie' between the two women and consider whether Ms. Neumann provides support *more often* than Ms. Morgenstern due to the higher costs of providing support that Ms. Morgenstern has.

This book studies the following questions:

1. *Is mutual support more likely if actors are homogeneous or if they are heterogeneous with respect to one or several individual properties?*
2. *Is mutual support more likely if actors are heterogeneous with respect to one individual property or if they are heterogeneous with respect to several individual properties? Do heterogeneous individual properties interact, and if so, how?*
3. *Does an increase of heterogeneity in one or several individual properties between the actors lead to more or less mutual support?*

In the following sections, we introduce the main characteristics of durable support relations, as well as the essential features of heterogeneity, as studied in this book. We use a game-theoretic approach to model support relations and to derive hypotheses that are tested by laboratory experiments. In Section 1.2, we discuss social support in durable relations and present a sketch of a model of social support which we study in more detail in later chapters. In Section 1.3, we specify in greater detail the effects of heterogeneity in different social dilemmas and define 'heterogeneity' in comparison to 'asymmetry'. Section 1.4 provides an overview of the book.

1.2 Social Support

1.2.1 Social Support in Durable Relations

Supportive or cooperative behavior in durable and dyadic relations is intensively studied, both theoretically and empirically. We follow rational choice theory and adopt an actor-oriented approach. Providing support, or more generally cooperation, is thus conceived as incentive-guided behavior (Harsanyi 1976, Becker 1981, Axelrod 1984, Coleman 1990, Cook and Levi 1990, Ellickson 1991, Voss 2001, Buskens 2002, Diekmann and Voss 2004). The basic 'units' of a support relation in a rational actor model are (at least) two actors. We assume that actors pursue self-interested goals and that each actor rationally chooses among various means to achieve his or her goals. Thus, a rational choice is one in which the actor takes the best available action, given his or her preferences (e.g., Raub and Voss 1981: Chapter 1, Voss 1985: Chapter 1). The structure of a support relation is such that an actor can provide benefits for another actor at certain costs to him or herself. Actors can choose between providing and not providing support. They maximize their benefits and minimize their costs. We restrict our attention to situations in which actors are assumed to be unable to make enforceable binding agreements or commitments towards each other's behavior ('non-cooperative game').

The interaction structure of a dyadic and durable support relation is similar to an iterated Prisoner's Dilemma (Luce and Raiffa 1957, Rapoport and Cammah 1965, Maynard Smith 1984). Each actor has an *incentive* not to provide support, but prefers to receive the benefits from being supported. Ignoring differences in the likelihood of needing support, both actors are better off if mutual support is provided, given the benefits from receiving support exceed the costs of providing support. In this sense, the long-term benefits of mutual support can be higher than the short-term benefits of individually refusing to provide support. Support in a durable relation can be based on the possibility that actors can threaten each other – probably implicitly – with refusing to provide support and that actors can promise each other – again, implicitly – rewards for being supported. This mechanism is known as *reciprocity* or *conditional cooperation* (Dawes 1980, Carnevale et al. 1982, Axelrod 1984, Taylor 1987, Kollock 1998). We show that providing support can be conceived as a cooperation problem in the sense that actors are better off when mutual support is provided compared to the situation where no social support is provided at all. Moreover, considering heterogeneity in costs of providing support, benefits from receiving support, and the likelihood of needing support evidently relates to social inequality. Our study consequently contributes to the interplay of the core problems of social science – cooperation problems and problems of inequality (see Ultee et al. 2003).

We limit ourselves to *dyadic* relations. Heterogeneity among more than two actors opens up a bewildering set of additional possibilities that we feel is best postponed until the two actors situation is well understood. We furthermore focus on *durable* relations and do not study incidental support to a stranger (e.g., Frank 1989, Baurmann 2002, Brennan and Pettit 2004). Supporting a stranger is not motivated by benefits obtained by an actor in return. Mutual support in one-shot situations cannot be based on future rewards, and consequently cannot be based on threats and promises leading to reciprocal behavior. Hence, the study of support to a stranger requires a different theoretical approach.

So far, we have addressed the rational choice literature on supportive and cooperative behavior. The basic conceptualization of social support, as an exchange relation, has also been extensively discussed by social psychologists and social exchange theorists such as Thibaut and Kelley (1959), Homans (1961), Emerson (1962, 1972) and Blau (1964), and has been subsequently developed by, e.g., Cook and Emerson (1978) and Molm (1987, 1989, 1990, 2003). Homans (1961: 13) describes social support as "an exchange of activity (…) more or less rewarding or costly, between at least two people". Social exchange theorists extensively discuss the difference between economic exchange and social exchange. While in economic exchange the type and the time of the rewarding action is precisely defined, this is not the case in social exchange. The benefits of social support are, to some extent, unspecified (Blau 1964: 93). An actor cannot be sure what the future reward will be. Consider the following example. To reward the received support, Alter spends hours in the kitchen to cook a delicious three-course meal for Ego. However, next time Ego receives support from Alter, Ego might reward Alter with a simple pasta. An actor cannot be sure when the future reward will be received, since there is a time-lag between providing and receiving support (Coleman 1990: 91). Theoretically, as well as in our experimental tests, it is not precisely specified at what time support can be returned, since Ego can be in need of support from Alter several times before having the opportunity to provide support (in return) to Alter. Our concept of social support is somewhere 'in between' social exchange and economic exchange (see Coleman 1988).

The literature on exchange theory, as well as on rational choice theory, derives hypotheses from cost and benefit considerations. The general hypotheses and findings are that social support, conceived as incentive-guided behavior, is more likely if the benefits from receiving support are higher, the costs of providing support are lower, and the relation is more durable (e.g., Brown 1986, Smith and Mackie 1995). Our theoretical analysis leads to similar predictions. However, we are particularly interested in how *homogeneity* and *heterogeneity* in costs and benefits, as well as in the likelihood of needing support between the actors affects mutual support, rather than how an increase or decrease of the costs of providing support and the benefits from receiving support affects social support. Nevertheless, we shortly review some findings based on experimental literature on incentive-guided behavior. While there are always exceptions (e.g., Camerer 2003), the results of experiments based on payoff variations with respect to Prisoner's Dilemma situations are usually in line with common-sense theory predictions. Increasing the 'reward' payoff ('R') of mutual cooperation in comparison to the 'punishment' payoff ('P') of unilateral cooperation, leads to more mutual cooperation (see Figure 1.2 in Section 1.3.2). Thus, the larger the rewards relative to the costs, the more likely are the subjects to provide support (see for an overview, Colman 1982, Section 7.3). Most experiments based on public good games also confirm assumptions on incentive-guided decision making. Isaac et al. (1988) vary the contributions and rewards in public good game experiments and show that subjects respond to incentives in the expected way, namely the larger the 'marginal per capita return', the more likely are the subjects to contribute to the public good (see for an overview, Kagel and Roth 1995, Chapter 2). However, these findings have all been based on homogeneity assumptions. Little is known of how these findings generalize to heterogeneous situations.

1.2.2 Modeling Social Support

In this study, we repeatedly refer to a specific model, the *Iterated Support Game* (ISG) as a stylized representation of dyadic, durable support relations (see for a similar game Weesie 1988: 114, Hegselmann 1994a, 1994b, 1996, as well as the 'image scoring game' of Bolton et al. 2005 and the 'delayed exchange dilemma game' of Back and Flache 2006). We first consider the constituent Support Game (SG). Social support involves two actors, actor A and

B. Both actors are occasionally in need of support and both actors occasionally can provide support; today actor A may need support from actor B, however, tomorrow actor B might be in need of support from actor A. Actor A's likelihood of needing support is π_A. Actor B's decision to support or not to support actor A is based on the assumption that actor B knows – and takes into account – that he or she may be in need of support from actor A in the future. Let us consider the situation that A needs support. If A does not get support, A's outcome is 0. If A receives support, A's outcome is the benefit $b_A > 0$ of received support. Actor B, who is not in need of support, has to decide whether to support or not to support A. If actor B does not support A, the outcome for B is 0. If actor B does provide support, it is costly and B's outcome is minus the cost $c_B > 0$ of providing support. We assume that the benefits of an actor i from receiving support are larger than the costs to i for providing support, $b_i > c_i > 0$.[1] Figure 1.1 presents the extensive form of the SG.

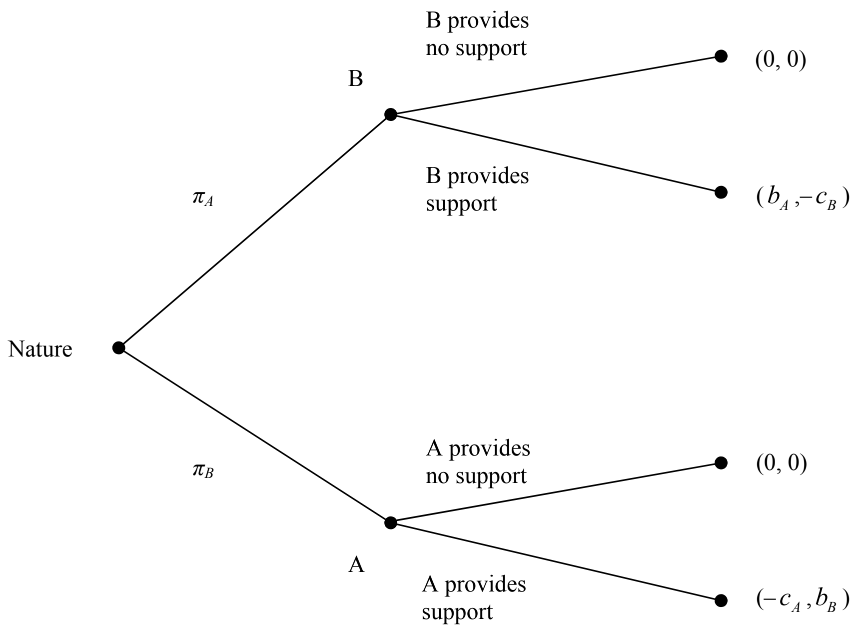

Figure 1.1 Extensive form of the Support Game (SG), with $b_i > c_i > 0$. The ISG is an iterated version of this game over time.

The ISG is an iterated version of the constituent game over time. We therefore assume that the SG is repeated indefinitely often with the continuation probability w and that exactly one actor needs support at each time point. Unlike the Prisoner's Dilemma, the ISG is played non-simultaneously. This simplifies our analysis somewhat. Moreover, we feel that many situations in sociology that are normally modeled by the iterated Prisoner's Dilemma are more

[1] Note that we do not compare b_i with c_j. In this study, we avoid interpersonal comparison of utilities.

reasonably modeled by the ISG. We discuss the differences between the Prisoner's Dilemma and the ISG in greater detail in Section 1.3.2. The ISG is presented and analyzed in detail in Chapter 2.

The ISG is the focus of our theoretical analysis and is used as a template for experimental tests. Laboratory experiments are particularly suitable to test hypotheses on the effects of heterogeneity and homogeneity between actors, since the relevant variables (heterogeneous and homogeneous costs of providing support, benefits from receiving support, likelihood of needing support) are controlled directly by the experimenter, leading to high internal validity (see Glaeser et al. 2000 for a similar point about experimental research on trust). We do not discuss the experiments in detail in this introductory chapter. We use different experiments in different chapters and the experiments are introduced in detail in the corresponding chapters.

1.2.3 Similarity between Actors and Social Support

There is a variety of literature on similarity and social support (see McPherson et al. 2001 for an overview). These studies consider similarity and, respectively, dissimilarity[2] of actors in a wide variety of aspects, ranging from socio-demographic and behavioral dimensions to attitudes and abilities: race and ethnicity, gender, age, religion, education, occupation, social status, network positions, beliefs, or aspirations. Most of these studies find positive effects of homogeneity (mostly called similarity or homophily) on supportive behavior (e.g., Lazarfeld and Merton 1954, Merton 1968, Feld 1982, Marsden 1988, Dovido et al. 1991, Smith and Mackie 1995). Why, actually, are similar actors expected to provide more support than dissimilar actors? Mostly, the explanations are based on actors' *preferences*. The main argument underlying this reasoning suggests that homogeneity creates feelings of 'connectedness' or 'empathy' between people, which in turn creates supportive behavior. Explanations that invoke particular preferences tend to trivialize explanations – though are not necessarily untrue. We study whether similar predictions can be derived for social support, considered as incentive guided behavior. Most of the literature on similarity and social support does not employ assumptions on incentive-guided behavior and social support as a social dilemma situation. We want to give a more solid argument why social support is facilitated by homogeneity than referring to effects of homogeneity in preferences.

1.3 Heterogeneous Actors

1.3.1 Heterogeneity in Social Dilemmas

The ISG is a variant of the iterated Prisoner's Dilemma Game. In these types of dilemmas, heterogeneity is usually expected to have a *negative effect* on mutual support (e.g., Rapoport

[2] Note that the labels *dissimilarity*, *heterogeneity*, and *asymmetry* are used in different disciplines, with sometimes overlapping but also sometimes different connotations. See Section 1.3.2 for further discussion.

1974, Kollock 1998). In a Prisoner's Dilemma situation, supportive behavior in terms of a Pareto optimal outcome requires that each actor contributes, while all actors have incentives to deviate. The main intuitive argument that support is less likely in social dilemmas of the type of a *heterogeneous* repeated Prisoner's Dilemma than of a *homogeneous* one is the following. The actor with less interest or resources (smallest payoff) has the highest incentive not to provide support in a Prisoner's Dilemma-like situation (Murninghan et al. 1990, Murninghan and King 1992). Assuming that both actors take each other's perspectives into account, both actors will choose not to provide support and the outcome is suboptimal. Thus, to maximize cooperative behavior in Prisoner's Dilemma-like situations, the minimum incentives to cooperate should be maximized. As we will see in Chapter 2, this often means that homogeneous actors are most likely to provide support. Such predictions are partly confirmed by laboratory experiments (see Murninghan and King 1992).[3]

However, it is important to stress that heterogeneity has different effects in different types of social dilemmas. In social dilemmas such as exemplified by the Volunteer's Dilemma, heterogeneity *facilitates* mutual support (Diekmann 1993, Weesie 1993). In this type of public good dilemma, the production of a collective good requires contributions by a single actor. An outcome in which too many actors contribute would be suboptimal, just as the absence of contributors would be suboptimal as well. Various theoretical analyses (Olson 1965, Coleman 1990, Oliver et al. 1993) argue that the actor who is most interested or has most resources is the most likely to volunteer. An example is the rescue of a child who has wandered too far into the sea. Bystanders have the aim to rescue the child. It would be sufficient if only one bystander goes into the water to rescue the child (see Diekmann 1993, Weesie 1993). If all bystanders know that the father is among the bystanders, it is most likely that only the father will jump into the water to rescue the child, since he has the highest interest. Generally spoken, the main argument here is that heterogeneity of interests or resources facilitates collective action, because it increases the likelihood that a 'critical mass' of at least one highly interested or resourceful actor will produce the collective good (e.g., Hardin 1982, Oliver et al. 1985). Olson and Zeckhauser (1966) and Olson (1965) argue that, since everybody knows that the actors that are most interested in the public good will actually produce it, the less interested actors can thus exploit the most interested one. Olson describes this as "exploitation of the strong by the weak" (Olson 1965: 29).

1.3.2 Actor Heterogeneity versus Asymmetry in Payoffs

There are different ways to study the effects of heterogeneity in Prisoner's Dilemma-like games. In this study, we are interested in heterogeneity at the *individual level*, so called 'actor heterogeneity'. Actor heterogeneity refers to differences in tastes, interests, resources, etc.

[3] We use 'confirmed', 'not confirmed', and 'rejected' in the standard sense of statistical tests of hypotheses. More precisely, by using the label 'confirmed' we do not wish to suggest that hypotheses could be verified in a sense that would be inconsistent with Popperian methodology, broadly conceived.

between the actors. In this book, we study heterogeneity in individual properties that are relevant for durable support relations, namely, the *benefits* from receiving support, the *costs* of providing support, and the *likelihood* of needing support.

Most of the literature that focuses on heterogeneity in Prisoner's Dilemma Games reduces the analysis of heterogeneity at the individual level to an analysis of *asymmetry* in (expected) *payoffs* (e.g., Sheposh and Gallo 1973, Murninghan and King 1992). How actor heterogeneity in interests or resources leads to asymmetry in the (expected) payoffs is, however, usually not specified in the literature. The ISG allows us to explicitly link underlying individual properties and heterogeneity in such properties to the expected payoffs of the game. In comparison to the (repeated) Prisoner's Dilemma Game, the ISG thus provides a substantive interpretation of differences in actors' (expected) payoffs.

Figure 1.2 shows the difference between the one-shot Support Game and the one-shot Prisoner's Dilemma Game, in terms of the payoffs in strategic form. However, the comparison holds true for the iterated versions.

		Prisoner's Dilemma		Support Game	
		Actor B		Actor B	
		Support	No support	Support	No support
Actor A	Support	R_A, R_B	S_A, T_B	$b_A\pi_A{-}c_A\pi_B,\ b_B\pi_B{-}c_B\pi_A$	$-c_A\pi_B,\ b_B\pi_B$
	No Support	T_A, S_B	P_A, P_B	$b_A\pi_A,\ -c_B\pi_A$	0, 0

Figure 1.2 Prisoner's Dilemma and Support Game (SG), with $T_i > R_i > P_i > S_i$, and $b_i > c_i > 0$.

A Prisoner's Dilemma Game is asymmetric if, for example, the two actors differ with respect to the reward payoff *R*. But what does this mean? Do the actors' interests differ? But then, why do they only differ with respect to the reward payoff *R* and not with respect to any of the other payoffs? In the Support Game, *R* is derived from individual properties. If actor A provides support at costs c_A and receives support at benefits b_A, A gets the (expected) payoff '$b_A\pi_A{-}c_A\pi_B$' from mutual supportive behavior. For other combinations of behavior, similar simple expressions in *b*, *c*, and π hold. Thus, heterogeneity in the costs of providing support, the benefits from receiving support, or the likelihood of needing support affects different payoffs in different ways. All payoffs in the SG are modeled in terms of two or three of the individual properties. The payoffs of the Prisoner's Dilemma are not modeled in an interrelated way, and so comparative analysis is not well possible.

In most of the literature on asymmetry in Prisoner's Dilemma Games, not only the asymmetry between the (expected) payoffs varies, but also the 'total amount' of the (expected) payoffs varies, i.e., the incentives to provide support or not to provide support vary. For example, Schellenberg (1964) and Sheposh and Gallo (1973) consider asymmetric Prisoner's Dilemmas in which the actors' (expected) payoffs are proportional. And Murninghan and King (1992), for example, compare several asymmetric Prisoner's Dilemmas with each other in a similar way. Such a comparison mixes up the effects of heterogeneity in the payoffs and the effect of the increase or decrease of actors' incentives on mutual support. A better analysis keeps the 'total amount' of the payoffs fixed and studies the consequences of varying the *distribution* of the variables between the actors. This can be best shown by a numerical example. Compare actor A and B having equal support costs $c_A = c_B = 5$, with actor A having support costs of $c_A = 4$ and actor B of $c_B = 6$. The total of the costs of providing support is fixed with $c_A + c_B = 10$. However, if we compare the homogeneous relation with a relation in which actor A's costs are $c_A = 5$ and actor B's costs are $c_B = 6$, we see that the 'total amount' of the costs increased in the later setting to $c_A + c_B = 11$. In this case we cannot disentangle the effect of heterogeneity in the costs from the effect of the 'general' increase of the 'total amount' of the costs from 10 to 11. In terms of the example of the neighbor women, we can compare Ms. Morgenstern and Ms. Neumann, both having a seven year old child, with Ms. Neumann having a two year old child and Ms. Morgenstern having a twelve year old child. However, to compare both women having a seven year old child with Ms. Neumann having a two year old child and Ms. Morgenstern having a five year old child is somewhat meaningless. In the latter case, we increased the total costs of baby-sitting the children by decreasing the 'total amount' of the children's ages. We then cannot disentangle the effect of the heterogeneity and the effect of the increase of the total costs. If the actors have on average lower costs of providing support in the homogeneous than in the heterogeneous relation, it will be no surprise that mutual support is more likely under homogeneity than under heterogeneity.

With respect to social dilemmas belonging to the class of the Prisoner's Dilemma, asymmetry is often studied with respect to asymmetry in information (e.g., Aumann and Maschler 1995, Rasmusen 2001a, 2001b). Asymmetry in information means that actors differ with respect to information about each other's payoffs, the rules of the game, etc. An example of a game with asymmetric information is a game where Nature moves first and one of the actors cannot observe this move. Surprisingly, heterogeneity in even more basic elements such as actor heterogeneity has received less attention. Combining actor heterogeneity and asymmetry in information would make the analysis too complex. Therefore, we focus only on actor heterogeneity in individual properties, such as the costs of providing support, the benefits from receiving support, and the likelihood of needing support. Since we only focus on actor heterogeneity in this book, 'heterogeneity' from here onwards refers to 'actor heterogeneity'.

1.4 Overview of the Book

In Chapter 2, we develop a game-theoretic model that underlies the analyses of Chapters 3 through 5, the ISG. A number of hypotheses will be derived analytically. Chapter 3 presents tests of game-theoretic predictions derived in Chapter 2. The hypotheses are tested by a laboratory experiment. In Chapter 4, we study an extension of the micro-foundation. There we study whether social support is more likely in situations where Ego has the choice to provide Alter with support to enable Alter to seize an *opportunity of a gain* or alternatively, in situations where Ego can support Alter in order to prevent a *threat of a loss* for Alter. These situations are equivalent only if actors are risk neutral. Thus, Chapter 4 analyzes how individual differences with respect to risk preferences affect decisions in opportunity and threat situations. Additionally, the question will be answered whether the effect of heterogeneity varies in opportunity and threat situations. The hypotheses are tested by a laboratory experiment. Chapter 5 relaxes the rationality assumptions of the former chapters and studies the behavioral dynamics of social support between heterogeneous actors. Given the findings of Chapters 2 and 3, we shift our attention to study which actor actually provides support more often in a heterogeneous relation ('distribution of the pie'). We assume that depending on their own characteristics and those of their support partner, actors have an 'idea' about how often they should support others and how often those others should support them. Such 'ideas' take into consideration the differences between actors in the costs of providing support, the benefits from receiving support, and the likelihood of needing support. The 'ideas' are derived from social-psychological assumptions such as those used in equity theory and alternatively, from game-theoretic assumptions such as those used in bargaining theory. The predictions are tested using data from the two laboratory experiments described in Chapters 3 and 4. Note that, whereas the focus of Chapters 2 until 4 is on the 'size of the pie', Chapter 5 focuses on the 'distribution of the pie'. In Chapter 6, we summarize and discuss the findings of the different chapters. Since Chapters 2 until 5 have been written as independent articles, some overlap between the chapters is unavoidable in this book.

Chapter 2

Social Support between Heterogeneous Partners*

Abstract

This chapter derives hypotheses on how dyadic social support is affected by heterogeneity between the actors. We distinguish heterogeneity with respect to three parameters: the likelihood of needing support, the benefits from receiving support relative to the costs of providing support, and the time preferences. The hypotheses are based on a game-theoretic analysis of an iterated Support Game. We predict that, given homogeneity in two of these parameters, the prospect for mutual support is optimal if actors are homogeneous with respect to the third parameter as well. Second, under heterogeneity with respect to two of the parameters, support is most likely if there is a specific heterogeneous distribution with respect to the other parameter that 'compensates' for the original heterogeneity. Third, under weak conditions, the overall optimal condition for mutual support is full homogeneity of the actors.

* A slightly different version of this chapter is published in *Analyse & Kritik* (Vogt and Weesie 2004).

2.1 Introduction

This chapter seeks to improve the understanding of cooperation in *asymmetric* social dilemmas. We analyze the conditions under which asymmetry with respect to individual properties hampers or facilitates cooperation. The theoretical and experimental literature on social dilemmas predominantly analyzes cooperation in the *symmetric* Prisoner's Dilemmas and some related social dilemma games. A Prisoner's Dilemma is called symmetric if the payoffs of the actors are the same (up to an increasing affine transformation). Asymmetry studied in the literature so far mainly concerns asymmetry in information, i.e., differences between the actors' information about each other's payoffs, the rules of the games, etc. Asymmetry in the sense of 'actor heterogeneity' with respect to other aspects of interactions has received much less attention. Actor heterogeneity refers to differences in preferences, interests, resources, etc. between the actors involved. This chapter focuses on the consequences of actor heterogeneity on cooperation in games that are a variant of the Prisoner's Dilemma. Asymmetries that do not directly reflect differences in properties of actors, such as differences in positions in social networks or differential institutional treatment of actors, will not be addressed in this chapter.

We argue that actor heterogeneity likely has different effects on individual behavior and on collective outcomes in different types of social dilemma situations.[1] Our distinction resembles the 'production function' analysis of collective action (Oliver et al. 1985, Heckathorn 1992). In the first type, exemplified by the *Prisoner's Dilemma*, Pareto optimal outcomes ('cooperation') require that *each* actor contributes (Rapoport 1974, Dawes 1980), while *all* actors have incentives to deviate. If actors do indeed deviate, the resulting outcome is suboptimal (Kreps 1990, Fudenberg and Tirole 1992). A common example is environmental protection. Since time and attention are scarce recourses, everyone has incentives not to separate trash into paper, plastics, metals, glass etc., although everyone may agree that garbage separation is important to protect the environment. Everyone appreciates other people separating their trash, but they may abstain from such costly behavior themselves ('free riding'). If everyone does this, however, the resulting environment will be suboptimal. In the second class of problems, exemplified by the *Volunteer's Dilemma*, the production of the collective good requires contributions by a *sufficient number* of actors. An example is the rescue of a child who has wandered too far out to sea. Bystanders have the same aim – the child needs to be rescued. However, it is not necessary that all bystanders jump into the water to rescue the child. It is sufficient if one actor jumps into the water and rescues the child. This would be a Pareto optimal outcome (Diekmann 1993, Weesie 1993). If more than one actor were to jump into the water, the extra efforts would be wasted, and the outcome would be Pareto suboptimal. Olson and Zeckhauser (1966) illustrated this effect with contributions to the NATO alliance during the 1960's.

[1] Since we only focus on actor heterogeneity in this study, 'heterogeneity' refers in the following to 'actor heterogeneity'.

In a dilemma situation of the Prisoner's Dilemma type, the problem is the inducement of the actor(s) with the *least* interest in the production of the collective good to make a contribution. In terms of a Prisoner's Dilemma, the problem is the inducement of the actor(s) with the highest incentive to cheat. We want to indicate an analogy with the strength of a chain in terms of the strength of the links: to make a chain stronger, the *weakest link* has to be strengthened. With unlimited material, we can make all links stronger. With scarce resources, we can make the chain stronger by shifting material from the stronger links to the weakest link. In a chain of maximal strength, all links are equally strong, i.e., homogeneity is optimal. To the extent that this analogy is valid, we would expect that actor homogeneity offers optimal prospects for cooperation in a social dilemma of a Prisoner's Dilemma type.

The effect of heterogeneity on efficiency is different in the second class of social dilemmas, exemplified by the Volunteer's Dilemma. In this class of social dilemmas, an outcome, in which all actors contribute, is suboptimal. The production of the collective good requires the contribution of one actor only. Various theoretical analyses suggest that the actor who gains most from the collective good relative to the costs of producing it is the most likely volunteer. Therefore, the production of the collective good depends on the *strongest link*. Heterogeneity between the actors is likely to make the strongest link stronger, and thus facilitates cooperation. Different reasons have been suggested for the strong impact of the strongest link. Diekmann (1993) derives this prediction by using the theory of risk dominance, one of the prominent equilibrium selection theories of game theory. Weesie (1993) derives a similar prediction, using subgame perfection only, if actors are able to wait and see whether other actors made a contribution. A related argument can be found in mobilization and threshold theories of collective action. Olson (1965) argues that the actors who are more interested in the common good will provide the collective good, regardless of the actions of the group's less interested actors. The 'weak' can thus exploit the 'strong' because everyone knows that the 'strong' will produce the collective good anyway (Olson 1965: 29). Oliver et al. (1993) give a similar argument in their analysis of the critical mass of heterogeneous actors and collective action. Oliver et al. (1985) argue that heterogeneity of interests or resources facilitates collective action because it increases the likelihood that a 'critical mass' of highly motivated contributors will emerge to initiate the collective action (see for a similar argument, Hardin 1982). Coleman (1990: Chapter 9) argues that organizing collective action is more likely in a group that is heterogeneous with respect to normative constraints than in a group with homogeneous normative constraints. The modeling in this area has become increasingly sophisticated, but the main underlying argument remains the same (e.g., Granovetter 1978, 1985, Rapoport 1988, Rapoport et al. 1989, Heckathorn 1992). What all of the 'critical mass' theories or analyses of the Volunteer's Dilemma, like collective good problems, have in common is that the argument of the 'weakest link' is replaced by a 'strongest link' argument. Since these kinds of collective goods can be Pareto optimally produced by a sufficient number of actors, the best prospect for producing the good is to make sure that only a sufficient number of actors is maximally interested in producing the good.

Roughly, we conclude that negative effects of heterogeneity are to be expected in social dilemmas of the Prisoner's Dilemma type and that positive effects of heterogeneity are to be expected in social dilemmas of the Volunteer's Dilemma type. While these predictions are already theoretically well elaborated for the second class of dilemmas, this is not the case for the first class. Thus, the theoretical contributions of this book are concerned primarily with social dilemmas of the Prisoner's Dilemma type, namely Support Games.

2.2 Social Support between Heterogeneous Actors

Social support takes place in various situations and among various people. Common examples are persons helping a neighbor in the garden, children playing with other children's toys, women exchanging cooking books, and colleagues offering advice or helping out to meet deadlines (Homans 1958, 1961, Blau 1968). Why would people be willing to support other actors, i.e., use their resources for the aims of others rather than for their own aims? Following social exchange theorists such as Homans and Blau, we assume that social support, like other human actions, is based on rewards and costs. Supporting a stranger is likely not motivated by rewards obtained from the receiving actor in return. To explain why support is given to a stranger we would have to point to factors such as social norms or psychological processes such as upholding self-esteem etc. (e.g., Frank 1989, Baurmann 2002, Brennan and Pettit 2004). Typically, however, social support occurs in the context of *durable pairwise* relationships (Emerson 1976). In a durable relationship, it can be individually rational to provide support, because the actors on the receiving end may repay with support in the future. If Alter does not help Ego today, Ego might not help Alter next time either. In this sense, the long-term benefits of supporting each other can be higher than the short-term benefits of refusing support. Thus, support in durable relationships is based on the possibility that actors can threaten each other with the refusal of support and actors can promise each other rewards for providing support. This mechanism is known as *reciprocity* (Axelrod 1984). We do not consider 'generalized reciprocity', i.e., mutual support amongst more than two actors (e.g., Gouldner 1960, Yamagishi and Cook 1993).

Various factors influence these long-term benefits: first, there is a 'time-lag' between providing and receiving social support, creating a trust problem (Coleman 1990: Chapter 6). Second, people tend to value future rewards less than immediate rewards (Loewenstein and Elster 1992). Finally, the rewards in social support are to some extent unspecified (Blau 1964: 93). Alter can never be sure what his or her future reward will be. For instance, if Alter takes time to explain to Ego how to use a new computer program, Ego might reward Alter later with an invitation for dinner of unspecified quality.

The interaction structure of social support is similar to a (repeated) Prisoner's Dilemma (Weesie 1988: 114). Each actor has an incentive not to provide support, but prefers to receive the benefits from being supported. Mutual support is efficient if the benefits from received support exceed the costs of providing support. The payoffs of the Prisoner's

Dilemma may be asymmetric, but the Prisoner's Dilemma by itself does not provide a simple interpretation of how asymmetric payoffs may arise from individual differences in preferences or resources. The social support interpretation makes it possible to link individual characteristics to the payoffs. The relevant characteristics of actors are the costs of providing support (c_i), the benefits from receiving support (b_i), and the likelihood of needing support (π_i) (Weesie 1988, Hegselmann 1994a, 1994b). We call the likelihood of needing support from now on 'neediness'. In the social support variant of social dilemmas, we can conceptualize the heterogeneity of actors as the dissimilarity of the actors with respect to these characteristics. We can now address how the individual characteristics affect whether support is being given. We can also analyze how heterogeneity at the individual level, i.e., heterogeneity in individual characteristics, affects the outcome at the dyadic level, i.e., social support between two actors.

The comparison of social support between heterogeneous actors with social support between homogeneous actors, however, is not straightforward. If we want to determine whether heterogeneity facilitates or hampers social support, we need to devise a method to link up support between homogeneous and heterogeneous actors; with which homogenous actors do we want to compare heterogeneous actors? If all homogenous actors have lower costs of providing support than the heterogeneous actors, it will come as no surprise that mutual support is more likely under homogeneity. But such a comparison is not very meaningful, as it mixes up two aspects: the 'size' of the pie and the 'distribution' of the pie. The 'size of the pie' refers to the sum of the probabilities that actors need support and to the sum of the incentives. The 'distribution of the pie' refers to the distribution of the total likelihood of needing support over the actors and the distribution of the incentives over the actors. The analysis of the consequences of heterogeneity is only meaningful if we keep the 'size of the pie' fixed. Thus, we keep the 'total amount' of the costs of providing support, the benefits from receiving support, and the likelihood of needing support fixed and study the consequences of varying the distribution of the parameters between the actors. This resembles the distribution of a fixed amount of tangible resources between the actors. Thus, we interpret the parameters c, b, and π as functions of resources. Similar approaches to study effects of 'inequality' can be found, for instance, in the literature on income inequality (e.g., Atkinson 1970, Sen 1997) and on insurance and uncertainty (Arrow 1951).

Social support is intensively studied, both theoretically (Homans 1958, 1961, Kelley and Thibaut 1959, Blau 1964) and empirically (Ben-Porath 1980, Kirmeyer et al. 1987, Robertson et al. 1991, Engelmann and Fischbacher 2002). This literature proposes many hypotheses that are related to our research. For instance, mutual support in a durable relationship is more likely if the benefits from receiving support are higher, if the costs are lower, and if the relation is more durable (Brown 1986, Smith and Mackie 1995: Chapter 12). Such hypotheses address individual characteristics. However, these are not the focus of our study. The degree of heterogeneity of actors is a dyadic characteristic, and this is intricately related to the (dis)similarity of actors. It is often found in the literature that social support is more frequently found between similar actors. The interpretation of this finding from the perspective of our model and from our results is discussed in Section 2.5.

2.3 A Model of Support

2.3.1 Description of the Model

We consider an interaction with two actors (Figure 2.1). At any time point, actors may need the support of the other actor. More precisely, at each time *t* one out of four events may occur: (1) actor A needs support, but actor B does not; (2) actor B needs support, but actor A does not; (3) neither actor A nor actor B needs support, and finally (4) both actors need support. If only one actor needs support, the other actor has two behavioral alternatives, namely to provide support or not to provide support. Providing support costs resources $c_i > 0$, i = A, B; receiving support is beneficial $b_i > 0$. The parameters *bi* and c_i are utility *differences*, not utilities. The benefits b_i are the differences between *i*'s utility, if *i* needs and receives support (x_i+b_i), and *i*'s utility if *i* needs but does not receive support (x_i). The costs c_i are the difference between *i*'s utility, if *i* does not need support and does not give support (y_i), and *i*'s utility if *i* does not need but does give support ($y_i–c_i$). We assume that the benefits from receiving support are larger than the costs of providing support, $b_i > c_i > 0$. This assumption reflects the situation that social support comprises the use of one actor's time to assist another actor in reaching his or her goals (Coleman 1988). Of the remaining events, one is simple: if neither of the actors needs support, no support has to be given. This event is valued by *i* at y_i. If both actors need support at the same time, we assume that no support can be given; this event is valued by *i* at x_i. Our results only depend on b_i and c_i. The behavioral choices of *i* are irrespective of x_i and y_i. Without loss of generality, we can simplify the presentation of our model and write $x_i = y_i = 0$. We assume $b_i > c_i > 0$.

Consider the example of two colleagues at work on Friday afternoon. Alter needs help putting 1400 questionnaires in envelopes in the next four hours, before the post office closes. Alter's colleague, Ego, has no pressing duties. In this situation, exactly one actor needs help and the other can decide whether to help or not. If Alter has to put the questionnaires in the envelopes alone, Alter may not finish the work in time. If Ego helps Alter, Alter will finish the job in time. The situation is different if both Ego and Alter have to put 1400 questionnaires in envelopes in the next four hours. Now they cannot help each other. Obviously, if neither Alter nor Ego has to put questionnaires in envelopes, neither of them needs help.

In our model it is determined at random which of the four events occurs, denoted by π_i, the probability that only actor *i* needs support at *t*, by π_0 that no actor needs support at *t*, and by π_{AB} that both actors need support at *t*. Thus,

$$\pi_A + \pi_B + \pi_0 + \pi_{AB} = 1, \text{ with } \pi_A, \pi_B > 0.$$

With probability $\pi_A + \pi_B = \pi_+ > 0$ exactly one actor needs support, while the other actor has to make a decision whether or not he or she provides support. How often support is needed and could also be given depends on different aspects of the interdependency situation. For instance, if an advertising agency has acquired a major assignment, all employees will be involved and might need some help from colleagues to get their part done in time. In this case, the probability π_{AB} that Alter and Ego need help at the same time will be relatively high. However, if Alter is doing the creative part of the work in the early phase of the project, while Ego has to present the results to the client later on, Alter and Ego will not need help at the same time. At the beginning of the project the probability π_A that Alter needs support is high, and at the end of the project the probability π_B that Ego needs help is high; the probability that they need support at the same time (π_{AB}) is low. During the summer holidays, the workload is light and the probability π_0 that no one needs help is relatively high.

The formulation above with four different events encompasses the models proposed by Weesie (1988) and Hegselmann (1994a, 1994b). In our model, as in Weesie (1988), always exactly one actor needs support. Hegselmann assumes that the actors need support independently in the sense of probability theory. As an example of such independence, consider the need for emotional support between friends. Ego and Alter require emotional support because of events that happen in their respective lives, at work, in relationships with other people, etc. Such events will be only loosely coupled; the occurrence of events for Ego will typically not depend much on what happens in the life of Alter. However, the likelihood of needing support can include a degree of dependency between actors. The independence assumption, however, is not fully innocent. As an example with dependency in the need of support, consider two neighboring farmers. After a long period of bad weather, a farmer will need the material support of other people to survive. However, the two neighbors tend to need support at the same time, and they will probably not be able to provide support. Thus, the dependencies of events affect the probabilities π_A and π_B that an actor needs support while at the same time the other actor is able to provide support. Informal support is not very efficient for ‘positively’ correlated risks; formal insurance schemes are able to pool risks that are geographically more dispersed. These risks are less correlated, and so in this case a formal support mechanism has an efficiency edge over informal support.

Figure 2.1 shows the extensive form of the Support Game (SG). Payoffs represent ‘utilities’ that correspond to the outcomes of the game. We assume that actors know the game, know that the other actor also knows the structure of the game they are playing, etc; technically, the structure of the game is common knowledge (Rasmusen 2001a, 2001b). The game is played non-cooperatively in the standard game-theoretic sense that actors are unable to make enforceable agreements or commitments.

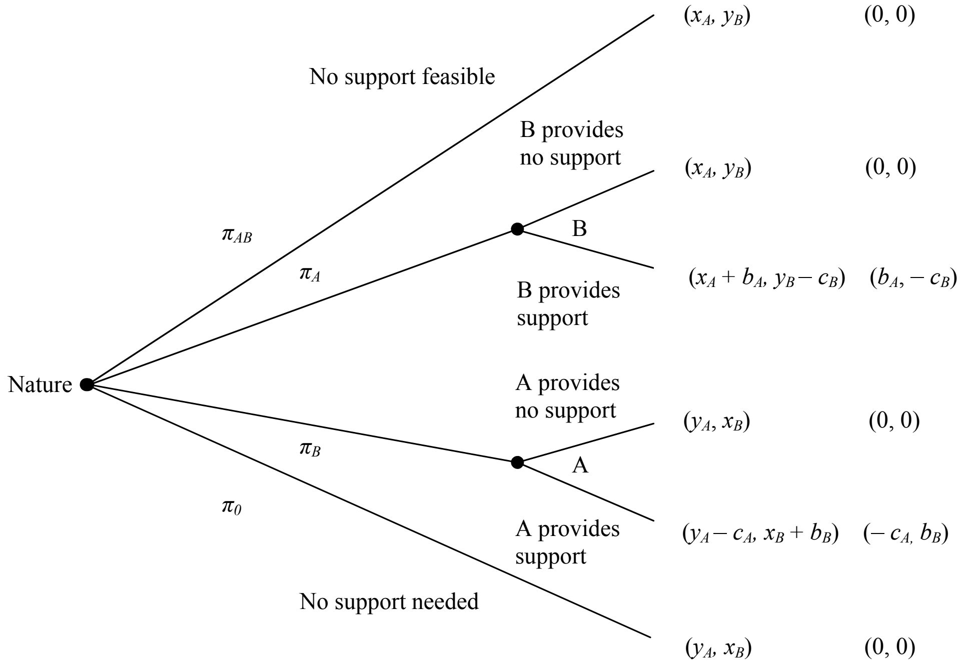

Figure 2.1 Extensive form of the Support Game (SG), with $b_i > c_i > 0$. The equilibrium behavior does not depend on (x_i, y_j). Without loss of generality we assume $x_i = y_i = 0$. The ISG is an iterated version of this game over time, with independent moves of Nature.

We want to study necessary and sufficient conditions for support in SGs: Under what conditions is it individually rational for the actors to provide support? The results for SG are actually trivial: There is a unique (subgame perfect) Nash equilibrium which states that neither actor provides support. This follows from the assumption that $c_i > 0$. This equilibrium is Pareto inferior compared to the situation in which *both* actors provide support in the events that support is needed by exactly one actor, if and only if the expected gains from received support exceed the expected costs of providing support,

$$\pi_i b_i - \pi_j c_i > 0 \text{ for } i = \text{A, B}, i \neq j. \tag{2.1}$$

Throughout this Chapter (2.1) is assumed. If (2.1) is met, individually rational behavior leads to a collectively irrational outcome (Rapoport 1974).[2] Under (2.1), the SG is a variant of the Prisoner's Dilemma game. It is a Pareto improvement for both actors to provide support instead of not to provide support, but it is individually rational not to provide support.

[2] It can be shown that, even if (2.1) does not hold, there is always a Pareto improvement in which at least one actor j always provides support $\alpha_j = 1$, while the other actor i provides support with some probability α_i, $0 < \alpha_i \leq 1$.

As discussed in Section 2.2, social support in a durable relationship is based on the principle of reciprocity. Hence, social support has to be studied not in a ‘one-shot’ game, but in the context of durable relationships: an Iterated Support Game (ISG). The example of the two colleagues provides some intuition why social support has to be modeled as an ISG. The giving of help and advice between colleagues is not controlled or organized by formal contracts between the colleagues. The underlying mechanism of mutual support is reciprocity; a colleague who provides support loses leisure time or might run into a delay with his or her own work. However, the long-term benefits can overcome Alter’s short-term incentive not to offer his own working time to help Ego. Next time, when Alter needs help, Alter will be better off if Ego rewards Alter for being helped before instead of refusing help. ‘Iterated’ games are games in which actors have to make similar choices repeatedly and they can take into account what has happened in previous periods of play (Fudenberg and Tirole 1991). It is well known that if an one-shot game with an inefficient outcome is repeated an indefinite number of times, it can be individually rational to exhibit efficient behavior, provided that the future is ‘important enough’ and deviations from Pareto optimal behavior are appropriately sanctioned (Friedman 1986: 103). In our application, an efficient outcome means that support is provided whenever support is needed and when giving support is possible.

Let us now address the issue of the importance of the future. In the theory of repeated games it is usually assumed that actors value the payoffs from the present game higher than the payoffs from future games. There are two reasons for the preferential treatment of the present. The first reason is negative time preferences: people prefer to benefit immediately, rather than later (Loewenstein and Elster 1992). A natural way to take this into account is to discount payoffs over time such that the payoffs from the next round are worth less than the payoff from the current round. The ‘weight’ that actor i assigns to the next round relative to the present one is called i's *discount parameter*

θ_i, with $0 < \theta_i < 1$.

Empirical evidence suggests sizable interpersonal differences in discounting that are, at least partly, socially produced (Gattig 2002). The second reason to down weight the future is that there is no assurance that future games will be played, because relationships may by then have ended. We thus distinguish the time discount parameter θ_i from the probability that after each round another round will be played. The continuation probability then is

w, with $0 < w < 1$.

We stress that the ‘objective’ continuation probability w is the same for both actors, while the ‘subjective’ individual discount parameter θ_i may well differ between the actors.

The payoffs of the repeated game can now be defined as follows: in every time period t, actor i obtains a payoff u_{it}. Here, $t = 0,1,2,\ldots$ is a discrete time parameter, and i = A, B indexes the actors. At each period t in which actor i does not play, he or she obtains a zero payoff, $u_{it} = 0$. The expected discounted payoff is the total payoff of an actor i associated with the infinite stream of payoffs $(u_{i0}, u_{i1,} u_{i2}, \ldots)$

$$\sum_{t=0}^{\infty} \theta_i^t Eu_{it},$$

where Eu_{it} is the expected utility for actor i at time t. Eu_{it} depends on the continuation parameter w, the strategies used by the players, and the benefits from receiving support, costs of providing support, and likelihood of needing support. For instance, if both players always provide support, the expected payoff attained at time t equals

$$Eu_{it} = w^t \left(\pi_i b_i - \pi_j c_i\right) + (1 - w^t)0 = w^t \left(\pi_i b_i - \pi_j c_i\right).$$

Here w^t is the probability that the relationship has continued up to time t. Thus, the expected discounted payoff obtained over the full interaction if both actors 'always provide support' is

$$\sum_{t=0}^{\infty} \theta_i^t Eu_{it} = \sum_{t=1}^{\infty} \theta_i^t w^t (\pi_i b_i - \pi_j c_i) = \frac{\pi_i b_i - \pi_j c_i}{1 - w\theta_i}. \tag{2.2}$$

The expected discounted payoff if both actors never provide support is 0. Expected discounted payoffs for other strategies can be derived in similar ways. Observe that the discount rate commonly included in repeated game models is now the product $w\theta_i$. The distinction between the discount parameter θ_i and the continuation probability w allows us to address how support in the ISG depends on the 'stability of the relation' indicated by the continuation probability w as well as the individual discount parameters θ_i.

The ISG is similar to games studied in the literature (Weesie 1988, Hegselmann 1994a, 1994b). In Weesie (1988), the focus is, as in this chapter, on the dyadic level and so on support generated by reciprocity. Differences in the discount parameters, however, are not taken into account. Hegselmann (1994a, 1994b) differentiates actors only by the likelihood of needing support, but they are able to search for a reasonable partner to exchange support with. Thus, in Hegselmann (1994a, 1994b) support is the consequence of market-like social processes.

2.3.2 Analysis of the Model

Now we can derive the condition for mutual support in the ISG. We focus on conditions under which actors are expected to support each other fully and at all time points. Thus, as the term is used here, 'mutual social support' means that both actors always provide each other with support. However, support will be given only if the long-term benefits of mutually providing support are higher than the short-term benefits of refusing support. The costs of providing support in the long run depend on the strategies used by the actors. We restrict our attention to trigger strategies. Trigger strategies are a particular implementation of reciprocity. A trigger strategy is a *totally unforgiving* strategy that employs *permanent retaliation*. A trigger strategy is never the first to refuse support, but if the other refuses support even once, a trigger strategy refuses support from that time onwards. Even after an own 'unintended' refusal of support, trigger strategies refuse support from then on. This is needed to ensure subgame perfection (Kreps 1990, Binmore 1998).

We do not claim that people in fact use trigger strategies. Furthermore, trigger strategies are not very suitable templates for the study of the dynamics of social strategies. Even though, the analytical treatment of trigger strategies is relatively easy; they do serve an important theoretical purpose. Trigger strategies are theoretically interesting for the study of the preconditions of cooperation. If mutual social support is not individually rational between trigger strategies, then mutual social support is not individually rational between other strategies either. This is the case because in this game having a permanent retaliation is the most severe punishment (Abreu 1988). The following lemma states the necessary and sufficient condition for an equilibrium in trigger strategies.

Lemma 2.1 A pair or trigger strategies (τ_A, τ_B) is a subgame-perfect equilibrium if and only if

$$\zeta^* = \max(\zeta_A, \zeta_B) \leq w, \tag{2.3}$$

where

$$\zeta_i = \frac{1}{\theta_i} \frac{c_i}{\pi_i b_i + (1-\pi_j)c_i} = \frac{1}{\theta_i} \frac{1}{\pi_i \eta_i + (1-\pi_j)}, \text{ with } \eta_i = \frac{b_i}{c_i} > 1.$$

For a proof of this lemma and the subsequent theorems we refer to Appendix A.

We observe that the equilibrium depends on the costs and benefits via the benefit-cost ratios denoted by $\eta_i = \frac{b_i}{c_i} > 1$. The benefit-cost ratio is a ratio of two utility differences, and so it is a scalar scale free quantity. Thus, interpersonal comparison of the preference parameter η_A and η_B is possible without indulging in the intricate problems of the interpersonal comparison of utility (Harsanyi 1977: Chapter 4, Coleman 1990: Chapter 29, Sen 1997). The equilibrium condition shows that mutual support depends on the dyadic continuation probability (w) and on all individual parameters: the benefit-cost ratios (η_i), the time-preferences (θ_i), and neediness (π_i). We will use this condition to predict the frequency of support under homogeneous and heterogeneous distributions of the parameters.

An important analytical result of the theory of repeated games is that cooperation is consistent with individually rational behavior in a repeated game if the continuation probability w is sufficiently large (Kreps 1990: Chapter 14). This result is replicated here. According to (2.3), it is individually rational to provide support if the continuation probability w exceeds the *dyadic threshold* ζ^*. If ζ^* decreases or w increases, the equilibrium condition 'is more easily met'. We will interpret this to mean that 'support is more likely' if ζ^* decreases or w increases. Keeping w fixed, ζ^* will then be treated as an indicator for 'how likely mutual support' is between the actors. The dyadic threshold ζ^* depends on the *individual thresholds* ζ_i. The individual threshold ζ_i increases in the benefit-cost ratio's η_i (i.e., increases in the costs and decreases in the benefits), and in neediness π_i, but decreases in the time preference θ_i. If ζ_A or ζ_B increases, ζ^* increases as well. Analogously, ζ^* decreases if ζ_A and ζ_B decrease. Therefore, $\zeta^* = \max(\zeta_A, \zeta_B)$ increases in η_i, and decreases in π_i and θ_i for both actors. This result is in accordance with the empirical findings on social support mentioned in Section 2.2.

2.3.3 Heterogeneity between the Actors

We model heterogeneity of the actors as interpersonal differences in the benefit-cost ratios (η_i), in neediness (π_i), or in the time preferences (θ_i). Actors are called *homogeneous* if they do not differ with respect to the individual parameters,

$$\eta_A = \eta_B,\ \pi_A = \pi_B,\ \text{and } \theta_A = \theta_B,$$

otherwise the actors are said to be *heterogeneous*. The continuation probability w is always the same for both actors. For instance, if Alter stops working at a company, the work relation between the colleagues Ego and Alter ends for both of them.

We argue that a comparison of social support between homogeneous actors with social support between heterogeneous actors is meaningful if the 'total amounts' of the homogeneous and heterogeneous distributed parameters are fixed

$$\eta_A + \eta_B = \eta_+,\ \pi_A + \pi_B = \pi_+,\ \text{and } \theta_A + \theta_B = \theta_+. \tag{2.4}$$

This is our *constant-sum condition* or *budget constraint*. Under this condition, we cannot reduce the individual parameters of both actors at the same time. If we decrease one individual parameter, for instance, the benefits of actor A, we have to increase the benefits of actor B so that the sum of the benefit-cost ratio is not affected ($\eta_A + \eta_B = \eta_+$). To keep the sums η_+, π_+ and θ_+ fixed resembles the distribution of a fixed amount of a tangible resource between the actors. The interpretation of a distribution of a tangible good seems appropriate for the benefit-cost ratios and for neediness. Differences in costs and benefits and in neediness reflect differences in resources. The interpretation is admittedly less compelling for the psychological discount parameters. To give a numerical example, we assume a homogeneous distribution of all parameters, except of the distribution of the costs, which is heterogeneous. If we assume that $\eta_A + \eta_B = 6$, we can compare $\eta_A = \eta_B = 3$, with $\eta_A = 4,\ \eta_B = 2$ or $\eta_A = 5,\ \eta_B = 1$. Thus, we can study the effects of an increase of heterogeneity in the benefits-costs ratio. Heterogeneity is conceived as an unequal distribution of at least one parameter between the actors. The equilibrium condition is least restrictive if ζ^* is minimal under every possible distribution of the individual level parameters, given the constant-sum condition (2.4). We use the phrase 'distribution' of a parameter to stress that changes at the individual level should not violate the constant-sum condition that ensures that a meaningful comparison of social support between homogeneous and heterogeneous actors. Now, the minimization of

ζ^* is not equivalent to minimizing ζ_A and ζ_B at the same time. Given the budget constraint, if ζ_A decreases, ζ_B necessarily increases.

2.3.4 Theorems

To illustrate how social support is affected by different distributions of the parameters between the actors, we consider a numerical example with homogeneity with respect to the benefit-cost ratio η and the time discounting parameter θ,

$$\eta_A = \eta_B = 3, \text{ and } \theta_A = \theta_B = 1.$$

First, we consider homogeneity with respect to the need of support, $\pi_A = \pi_B = \frac{1}{2}$. According to Lemma 2.1 support can be expected if the continuation probability w is larger than or equal to the dyadic threshold

$$\zeta^* = \max\left(\frac{1}{1}\frac{1}{\frac{1}{2}\frac{9}{3}+(1-\frac{1}{2})}, \frac{1}{1}\frac{1}{\frac{1}{2}\frac{9}{3}+(1-\frac{1}{2})}\right) = \max\left(0.5, 0.5\right) = 0.5 \,.$$

Next, we consider heterogeneity with respect to neediness, $\pi_A = \frac{1}{3}$ and $\pi_B = \frac{2}{3}$. In this case the dyadic threshold ζ^* for individual rational mutual support is

$$\zeta^* = \max\left(\frac{1}{\frac{1}{3}\frac{9}{3}+(1-\frac{2}{3})}, \frac{1}{\frac{2}{3}\frac{9}{3}+(1-\frac{1}{3})}\right) = \max\ (0.75,\ 0.37) = 0.75.$$

Hence, the equilibrium condition is more restrictive in the heterogeneous case than in the comparable homogenous case. Figure 2.2 shows how the individual thresholds ζ_A and ζ_B, and the dyadic threshold ζ^* vary with π_i. The figure shows that ζ^* is minimal if the individually thresholds are equal, $\pi_A = \pi_B = \frac{1}{2}$, i.e., social support is 'most likely' under homogeneity.

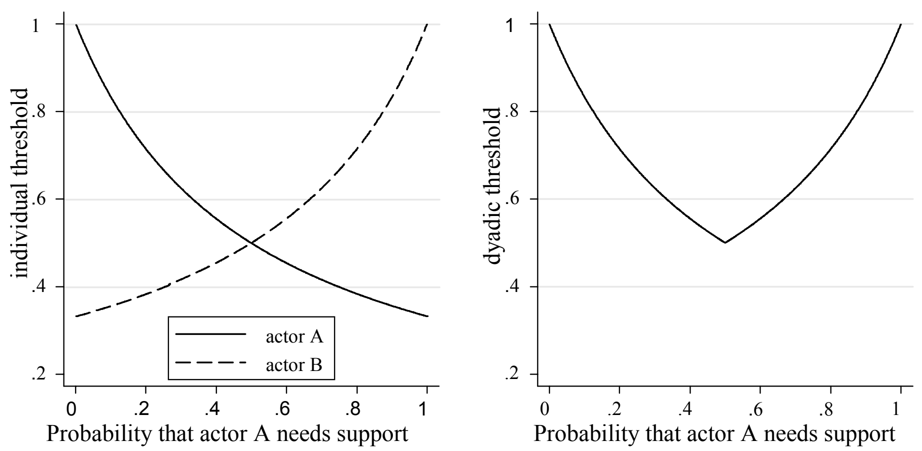

Figure 2.2 Numerical example of Theorem 2.1 (heterogeneity in one parameter).

To provide some intuition why homogeneity facilitates social support, we consider the analogy discussed in the introduction. We want to make a chain as strong as possible, using the available iron and carbon. With two links and equal amounts of iron already dedicated to produce each of the links, how then should the carbon be allocated? The strength of the chain is that of the weakest link, as the weakest link is the first to break under pressure. Clearly, we should make both links equally strong. An unequal distribution of carbon would make one link stronger than the other. Since the chain is as strong as its weakest link, the extra carbon used in the stronger link is wasted; the chain is not optimal. The chain would become stronger if some carbon is shifted from the more affluent link higher in carbon to the link poorer in carbon. In an optimal chain, assuming that the iron was distributed equally, the carbon has to be distributed equally as well.

The following theorem states that the example above generalizes beyond the arbitrary numbers of the example, and also applies to heterogeneity with respect to the other individual level parameters.

Theorem 2.1 (heterogeneity in one parameter): *Consider an ISG with heterogeneity in one parameter $\mu \in \{\eta, \pi, \theta\}$ and homogeneity in the remaining two parameters. In this case ζ^* is minimal if μ is distributed equally between the actors, $\mu_A = \mu_B$, and so $\zeta_A = \zeta_B = \zeta^*$.*

Homogeneity is best if we allow heterogeneity only in a single dimension. Assume that Alter and Ego are colleagues. From time to time Ego and Alter have to run experiments. To do this they require each others' assistance - if they were to conduct the experiments at the same time, they could not assist each other. If Alter assists Ego, it costs Alter time, if Ego assists Alter the situation is the same vice versa. If both actors require help from each other equally often the prospects for mutual support are optimal.

In our first example, we illustrated the optimal adjustment of one parameter if the other two parameters are homogenous. Now we consider an example with heterogeneity with respect to the costs and benefits and homogeneity with respect to time discounting.

$\eta_A = \frac{12}{3}$, $\eta_B = \frac{6}{3}$, and $\theta_A = \theta_B = 1$.

We want to study whether or not homogeneity, with respect to neediness, is still optimal. First, we consider again the homogeneous case, $\pi_A = \pi_B = \frac{1}{2}$. The dyadic threshold is

$$\zeta^* = \max\left(\frac{1}{1}\frac{1}{\frac{1}{2}\frac{12}{3}+(1-\frac{1}{2})}, \frac{1}{1}\frac{1}{\frac{1}{2}\frac{6}{3}+(1-\frac{1}{2})}\right) = \max(0.4, 0.7) = 0.7.$$

Next, we consider a particular heterogeneous distribution of neediness, $\pi_A = \frac{1}{3}$ and $\pi_B = \frac{2}{3}$. In this case we have

$$\zeta^* = \max\left(\frac{1}{1}\frac{1}{\frac{1}{3}\frac{12}{3}+(1-\frac{2}{3})}, \frac{1}{1}\frac{1}{\frac{2}{3}\frac{6}{3}+(1-\frac{1}{3})}\right) = \max(0.6, 0.5) = 0.6.$$

Thus, we see that in this example homogeneity in neediness does *not* lead to the minimum of ζ^*, i.e., equal need of support is not the most favorable condition for mutual support. The particular heterogeneous distribution of the π's that we looked at leads to a smaller dyadic threshold than a homogeneous distribution of the π's. It is, however, not the heterogeneity of the π's per se that facilitates mutual support. If the distribution of neediness is oppositely skewed, namely $\pi_A = \frac{2}{3}$ and $\pi_B = \frac{1}{3}$, ζ^* would be even larger than under homogeneity:

$$\zeta^* = \max\left(\frac{1}{1}\frac{1}{\frac{2}{3}\frac{12}{3}+(1-\frac{1}{3})}, \frac{1}{1}\frac{1}{\frac{1}{3}\frac{6}{3}+(1-\frac{2}{3})}\right) = \max(0.3, 1) = 1.$$

Since $0 < w < 1$, mutual social support is not individually rational under this condition, no matter how durable the relationship is. If $\pi_A = \frac{1}{3}$ and $\pi_B = \frac{2}{3}$, there is an *interaction effect* between the parameters; heterogeneity in one parameter (η) is *compensated* by heterogeneity in another parameter (π). Figure 2.3 displays the individual thresholds (ζ_i) and the dyadic threshold (ζ^*) for varying π_i. We see that mutual support is 'most likely' under a heterogeneous distribution of neediness. If $\pi_A = \frac{1}{3}$ and $\pi_B = \frac{2}{3}$, the individual thresholds are equal and the dyadic threshold has the smallest value. If $\pi_A = \pi_B = \frac{1}{2}$, ζ^* is larger, and furthermore we see that it is not the heterogeneity of the π's per se that facilitates mutual support, because ζ^* is even larger if $\pi_A = \frac{2}{3}$ and $\pi_B = \frac{1}{3}$. In this latter case, the heterogeneity in the two parameters re-enforces each other.

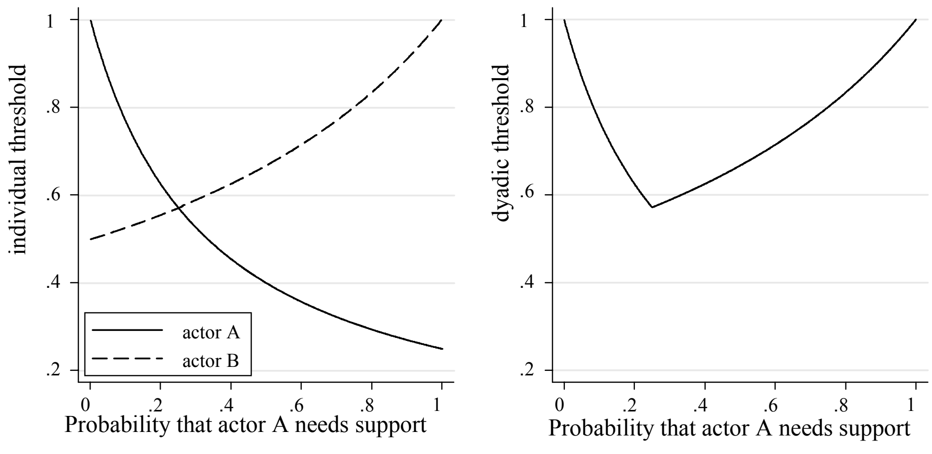

Figure 2.3 Numerical example of Theorem 2.2 (compensation).

We conclude that homogeneity in a given parameter is not necessarily 'optimal', irrespective of the distributions of the other parameters. If there is heterogeneity in one parameter, it is usually the case that better prospects for social support are possible if there is heterogeneity in the other dimension as well, provided that these heterogeneities are well aligned.

Theorem 2.2 (compensation): *Consider an ISG with heterogeneity in η, π, and θ. ζ^* is minimal in one of the parameters $\mu \in \{\eta, \pi, \theta\}$ if μ_A and μ_B are adjusted so that $\zeta_A = \zeta_B = \zeta^*$.*

While generally it is not true that homogeneity with respect to π, or any other parameter for that matter, favors mutual support, some form of homogeneity is beneficial, namely the *theoretical homogeneity* in terms of the individual thresholds ζ_i. These are the theoretical analogues to the 'strength of the link'. Considering the numerical example, but now with the general probabilities π_A and $\pi_B = 1 - \pi_A$, we have

$$\zeta_A = \frac{1}{1(\frac{12}{3}\pi_A + (1-\pi_B))} = \frac{1}{5\pi_A}, \text{ and } \zeta_B = \frac{1}{1(\frac{6}{3}\pi_B + (1-\pi_A))} = \frac{1}{3(1-\pi_A)}.$$

According to Theorem 2.2, the optimal ζ^* is characterized by $\zeta_A = \zeta_B$. Solving for π_A is $\pi_A = \frac{3}{8}$, and so the optimal dyadic threshold is $\zeta^* = \frac{8}{15}$.

We consider again the example of the two colleagues who assist each other during their experiments. We assume that Alter and Ego have equal benefits from receiving support. However, Ego runs experiments more often than Alter does. The optimal prospect for mutual support would then be that Ego's experiments are shorter than Alter's experiments. Thus, Alter has lower costs of providing support than Ego. The low costs of providing support interact positively with the high frequencies of running the experiments (compensation effect).

So far, we have analyzed how *one* parameter (μ) is optimally distributed, given how the other two parameters are distributed. We now analyze variations in all three parameters simultaneously, subject to the constant-sum condition (2.4). Each parameter can be distributed homogeneously or heterogeneously. How should the parameters be *simultaneously* distributed in order to make the condition for mutual support least restrictive? The question is answered in the next theorem.

Theorem 2.3 (homogeneity is globally best): Let $\pi_+ = 1$.[3] *The minimum of ζ^* subject to the constant-sum condition is attained by homogeneity with respect to each of the parameters, i.e.,* $\eta_A = \eta_B = \frac{1}{2}\eta_+$, $\pi_A = \pi_B = \frac{1}{2}$, and $\theta_A = \theta_B = \frac{1}{2}\theta_+$.

In the chain analogy, all material should be distributed equally between all links to make the chain as strong as possible. This is what happens if a chain out of steel will be produced: given some amounts of iron, zinc and copper, and no constraints on how the elements should be distributed to produce the chain, every link of the chain will have the same amount of iron, zinc, and copper. With respect to the example of the two colleagues, the optimal prospect for mutual support would be that both receive the same costs for assistance in conducting

[3] For a discussion of the technical assumption that $\pi_+ = 1$, see the proof of Theorem 2.3 in Appendix A.

experiments and the same benefits when receiving support with the own experiment, and that both need support equally often, i.e., both run experiments equally often.

2.4 Conclusion and Discussion

In this chapter we have argued that the effects of asymmetry in social dilemmas can be conveniently studied in terms of social support with asymmetry conceptualized as *actor heterogeneity* with respect to the costs of providing support, the benefits from receiving support, the likelihood of needing support, and how much actors value future rewards. Our analyses yielded a series of theorems. First, if there is homogeneity in all but one parameter, homogeneity in the remaining parameter leads to the optimal condition for social support. Second, if there is heterogeneity in at least one parameter, mutual support is most likely if there is a specific heterogeneous distribution of the other parameters that compensates for the original heterogeneity. Thus, homogeneity in a single dimension does *not* necessarily lead to the optimal condition of mutual support. Third, if all parameters are varied 'simultaneously', mutual support is most likely if all parameters are distributed equally between the actors. Thus, homogeneity in all dimensions is the globally best outcome.

A good intuition for our results can be obtained from the analogy of how to make a multiple-link chain as strong as possible. This is achieved by making the weakest link as strong as possible, and so we should make all links equally strong. There are however many ways to do this. Intuitively it is not implausible that the chain is indeed strongest if all links are the same. A sufficient reason for the optimality of homogeneity is *convexity* of the strength of links in terms of the amounts of different materials used, and so the different materials need to be *complementary*.

In the social support case, *all* actors need to be willing to stick to the implicit cooperative agreement enforced by trigger strategies. Thus, to facilitate cooperation, the individual thresholds of *both* actors should be as small as possible. We conclude that the individual thresholds have a similar role as the inverse of the strength of the links. Both individual thresholds are related due to the 'fixed mean' of the parameters: a decrease of Alter's individual threshold can be accomplished only by an increase of Ego's individual threshold and vice versa. Thus, making both individual thresholds as small as possible implies that the individual thresholds should be equal. To obtain the result that optimal individual thresholds involve homogeneity with respect to the parameters, however, requires additional arguments, just as we needed for the chain analogy. In the proof of Theorem 2.3 (see Appendix A), we show that the individual thresholds are indeed convex in the parameters. One can think of this as a positive interaction effect between any two of the parameters.

We want to emphasize that 'homogeneity is globally best' does not mean that 'less heterogeneity' between actors necessarily yields more cooperation than 'more heterogeneity'. Heterogeneity decreases if the distribution of any of the parameters is made more equal. However, if such a reduction in heterogeneity is performed in a parameter that was skewed to compensate for heterogeneity in another parameter, the compensation effect will become smaller, and so cooperation will be hampered, not facilitated. Numerical examples of this phenomenon were presented in Section 2.3. We turn again to our analogy for illustration. Evening the distribution of the construction materials out over the links does not necessarily make the chain stronger. Consider the example of a chain made out of copper and iron. The iron is distributed equally among all the links of the chain, except for one link that has only half the amount of iron. If we employ the copper equally, the link with less iron will still be the weakest link. If we put more copper in the link that is low in iron than in the other links, we will be using the materials less homogenously and this improves the strength of the chain.

This discussion may shed new light on the research of similarity in social support theory. Theories of social support often argue that 'similarity' between actors positively influences support behavior. The general idea is that in deciding to help or support, people take into account how similar the person in need is to them (e.g., Dovidio et al. 1991, Smith and Mackie 1995). The theories claim that similarity generally enhances cooperative tendencies such as conflict resolutions, support behavior etc.: "similarities in beliefs, attitudes, and values […] are usually conducive to […] cooperative resolutions of conflicts" (Deutsch 1973: 374). These theories generally study the effects of heterogeneity and homogeneity on social support in variables such as age, gender, religion, social status, or education. It is very seldom that the effects of *different degrees* of homogeneity and heterogeneity on support *between* several independent variables such as age, gender, etc. are compared with each other.

As an example of an article that uses homogeneity additively, we discuss Louch's article on network integration (Louch 2000). The article combines studies of transitivity and homophily (homogeneity in our terms) in an empirical analysis of personal network integration. For the purpose of our demonstration we focus only on the homophily hypothesis and neglect the other hypotheses. The hypothesis states that homophily improves the probability of integration in personal networks (triads). Louch uses race, gender, education, age, and religion to test this hypothesis. Using a logistic regression model, Louch analyses the simultaneous effects of all variables on the likelihood of a connection existing between triads. Louch uses the homophily variables additively in this model. The effect of each homophily variable is studied by keeping the other homophily variables constant. The effect of age is, for instance, studied by keeping education, religion, gender, etc. constant. Given the third theorem on compensation, we would expect an interaction effect between homophily variables. Since the difference in homogeneity and heterogeneity *between* the variables *per se* has an effect on support behavior, a cumulative analysis of homophily variables is misleading. The compensation theorem states a complex interaction effect between heterogeneous variables. Take as an example two colleagues assisting each other by running experiments. It may be the case that Alter runs experiments more often than Ego. This means that Ego has to assist Alter more often than Alter assists Ego. If the experiments of Ego and Alter take equally long, then we have a situation where in Ego has to help Alter more often and each time Ego helps it costs a lot of time. It is easy to imagine that Ego will not be willing to assist

Alter all the time. However, if Ego's experiments take much longer than Alter's experiments, then the situation is different. Now, Ego still has to help Alter more often, but since Alter always assists Ego for longer than Ego assists Alter, this situation might be more equal than the first situation. Only looking at differences in each of the variables separately, one would expect that heterogeneity in frequencies as well as in the length of the experiments make helping each other more problematic. However, it is clear for this example that the main predictor for supportive behavior should be the total time each person needs support, which is given by the interaction between frequency and length of the experiments. In other words, if someone needs support more often it is less costly for the others to support, if the heterogeneity in one dimension compensates the other. However, this interaction between the variables is neglected in the literature on homophily. The implicit assumption of most of the homophily analyses that it is generally better to have *more* dimensions that are homogeneous is not necessarily true. Given heterogeneity in one dimension, it can be even better for mutual support to have even *more* heterogeneous dimensions. Heterogeneity in one dimension can namely be compensated by heterogeneity in another dimension. However, the positive side of heterogeneity, namely compensation, is ignored in the literature on similarity or homophily.

We like to stress that *compensation* has nothing to do with *complementarity*. Complementarity may also influence the parameters of the game. Kelley and Thibaut (1959) emphasize that similar actors may not be *able* to provide each other with support. Complementarity of the actors is an essential precondition for mutual support. This issue was also apparent in the example of neighboring farmers; actors facing highly positively correlated risks are not complementary. Complementarity of actors allows them to provide support, because they are not in trouble themselves.

Finally, we want to discuss limitations of our analysis and possible remedies to overcome these shortcomings. We focus on all-or-nothing trigger strategies. Actors either provide full support, backed up by the threat to cancel all future support after any misdeed, or actors do not provide support at all. The restrictions of these two equilibria seem to some extent unreasonable. We are interested in heterogeneity between actors, but we study equilibria in which all actors use the same strategies. Maybe we should consider asymmetric equilibria that typically exist in iterated games (see 'folk theorem' results in, e.g., Friedman 1971, Kreps 1990). These asymmetric equilibria may be Pareto ordered, but may also be Pareto incomparable, leaving a bargaining problem. Who gains how much? To answer the question 'who gains how much', we suggest a study of the 'terms of trade' which can conveniently take the form of fractional support. In the model with fractional support, actors make decisions with respect to the degree α_i to which they give support, $0 \leq \alpha_i \leq 1$, with costs c_i and benefits b_i proportional to α_i (for an analysis of such a 'continuous game', see Nowak et al. 1989, 1999). For instance, either Alter helps Ego to search for participants for an experiment, or Alter only helps to analyze the results, or Alter helps with both, or Alter does nothing. In our analysis, we fixed $\alpha_i = 1$. Do we have any reasons to fix the α's in a certain way? If not, we face a selection problem of the α's. We need to address the bargaining problem and study the situation with a bargaining model (Nash 1950, Kalai-Smorodinsky 1975, Rubinstein 1982, 1990). However, in our case bargaining theories have a special disadvantage: the cooperation problem is solved 'by assumption', because bargaining theories assume Pareto-efficiency from the outset. As a solution, we may further use an evolutionary approach (Holland 1975, Axelrod 1984, Weibull 1995, Hofbauer and Sigmund 1998). By using an evolutionary approach, we provide an answer on (a) how likely social support is between heterogeneous actors and on (b) to what extent which of the heterogeneous actors provides support.

Chapter 3

Social Support between Heterogeneous Partners: An Experimental Test*

Abstract

This chapter studies how dyadic social support is affected by heterogeneity of the partners. We distinguish heterogeneity with respect to three parameters: the *likelihood* of needing support; the *benefits* from receiving support; and the *costs of* providing support. Hypotheses are based on a game-theoretic analysis of an Iterated Support Game. First, we predict that heterogeneity in one of the parameters hampers social support. Second, we predict that under heterogeneity with respect to two of the parameters, support is most likely if there is a specific heterogeneous distribution such that heterogeneity in one parameter 'compensates' for heterogeneity in the other parameter. If there is no compensation social support is even more hampered. The hypotheses have been tested by experimental data with a mixed within-subject, between-subject design. The data mostly confirm the hypotheses.

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* A slightly different version of this chapter is published in *Journal of Economic Interaction and Coordination* (Vogt and Weesie 2006).

3.1 Introduction

This chapter seeks to improve the understanding of social support between *heterogeneous* partners in *durable* relationships. We distinguish heterogeneity *between* actors with respect to *individual properties* such as *benefits* from receiving support, *costs* of providing support, and the likelihood of needing support (from now on called *neediness*). Individuals likely vary in these properties (e.g., Emerson 1962, 1972, Blau 1964, 1968). Take as an example two colleagues, Ego and Alter, who from time to time give each other advice. Ego might benefit more from this support relation than Alter does. At the same time, giving advice might be more costly for Ego than for Alter. Since Ego is less experienced than Alter, Ego needs advice more often than Alter does. What effects do these differences in the costs of providing support, the benefits from receiving support, and the likelihood of needing support have on the support relation? Is Alter unwilling to give advice because receiving advice is of little profit for Alter? Is Alter willing to give support because it is cheap for him or her to do so? Ego benefits a lot from receiving advice, but also pays a lot for giving advice. Does that make Ego more or less willing to provide support? Does it matter that Ego asks for advice more often than Alter does? It is not clear whether and how heterogeneity in *several* dimensions between persons facilitates or hampers social support. We suspect that heterogeneity in one dimension (e.g., Ego has higher costs of providing support than Alter does) leads to different behavioral consequences than heterogeneity in several dimensions (e.g., Ego has higher costs of providing support *and* higher benefits from receiving support). We therefore want to study the effects of heterogeneity in *multiple* individual properties on social support *simultaneously*. Heterogeneity between actors is conceived as a *dyadic* characteristic, and this is intricately related to the dissimilarity of actors (e.g., Frank 1985). In the literature on similarity and social support, heterogeneity in several dimensions is seldom studied simultaneously.

In former analyses we have extensively studied support relations (Chapter 2). Using a game-theoretic model on social support, the Iterated Support Game (ISG), actors are characterized by their *neediness* of support, their *benefits* from receiving support, and their *costs* of providing support.[1] We introduce the ISG and the relevant predictions in more detail in the next section. We subsequently describe an experimental test.

3.2 The Game-Theoretic Model

3.2.1 A Model of Support

Social support occurs in the context of *durable* relations (Homans 1961, Blau 1964, 1968, Emerson 1976). In a durable relation, it can be individually rational to provide support because the other person may repay these services in the future. The underlying mechanism of mutual support is *reciprocity*. We exclusively study *pairwise* relationships. We model social

[1] We also analyzed effects of heterogeneity in time preferences. Since time preferences were not taken into account in the experimental test, we do not discuss them in this chapter.

support as an *Iterated Support Game* (ISG) (Figure 3.1, for a detailed discussion see Chapter 2). We explicitly allow the game to differ for the two actors; their payoff structures are made to differ. The labels 'A' and 'B' refer to the two actors. For general claims about the parameters we use i to refer to any actor A or B, and j if we need to refer explicitly to the other actor. At each time point, actor i needs support, with the likelihood of i needing support being denoted by π_i. At each time point one – and only one – actor needs support ($\pi_A + \pi_B = 1$).[2] If an actor i receives support from another actor j, i will benefit with an amount of b_i at costs c_j for j. The parameters b_i and c_i are utility *differences*, not utilities. The benefits b_i are the difference between actor i's utility if i needs and receives support ($x_i + b_i$), and i's utility if i needs but does not get support (x_i). The costs c_i are the difference between i's utility if i does not need support, and does not give support (y_i), and i's utility if i provides support to j ($y_i - c_i$). We assume that $b_i > c_i > 0$, i.e., the benefits to i of support received are larger than the costs to i if he or she helps the other actor j. Our results only depend on b_i, and c_i, behavior does not depend on x_i, and y_i. Without loss of generality we assume $x_i = y_i = 0$.

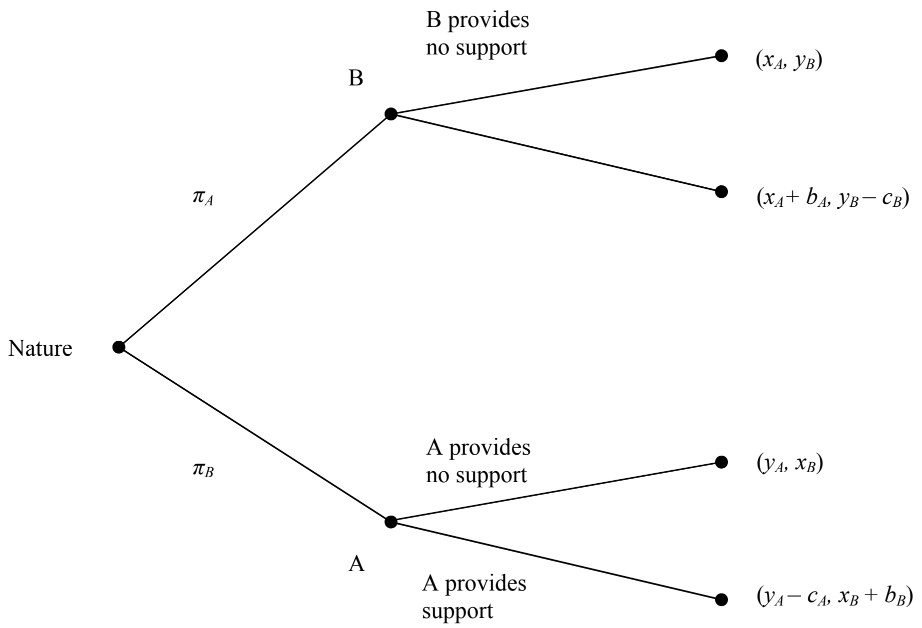

Figure 3.1 Extensive form of the Support Game (SG), with $b_i > c_i > 0$. The ISG is an iterated version of the Support Game over time.

The ISG continues after each time point with a constant continuation probability w, with $0 < w < 1$. With a probability 1–w the ISG ends. The game is played non-cooperatively in the

[2] The analysis holds true if $\pi_A + \pi_B < 1$, i.e., actors occasionally need support, assuming that actors have the same time preferences (see Appendix A).

standard game-theoretic sense, i.e., actors are not able to make enforceable commitments. The long-term benefits of giving support can outweigh the short-term incentives not to give support: if A does not support B today, B may not support A in the future. A and B would both be better off by providing and receiving support than by not providing and not receiving support at all, provided $\pi_i b_i - \pi_j c_i > 0$. If the common future ($w$) is 'long enough' support may be provided by rational actors (for a detailed discussion of how 'long enough' varies with the individual parameters, see Chapter 2).

We distinguish *heterogeneity* in the ISG in terms of neediness ($\pi_A \neq \pi_B$), benefits from receiving support ($b_A \neq b_B$), and costs of providing support ($c_A \neq c_B$). If two actors differ in at least one of the three parameters, actors are said to be heterogeneous, otherwise they are homogeneous. The ISG is said to be heterogeneous if the actors are heterogeneous.

3.2.2 Analysis

In Chapter 2, we present a game-theoretic analysis of the ISG. We derive an equilibrium condition for trigger strategies to see under which conditions rational partners provide support. Trigger strategies are a particular implementation of reciprocity. An actor using a trigger strategy never refuses support the first time around, but if support has been denied, the actor refuses support from then on. If two actors use trigger strategies, they will both always provide support. We do not claim that subjects actually use trigger strategies. However, the analytical treatment of trigger strategies serves an important theoretical purpose. If mutual support is not individually rational among actors using trigger strategies, then it is not individually rational among any other strategies either (e.g., Abreu 1988). Thus, we use the restrictiveness of the equilibrium condition for trigger strategies as an indicator how likely is mutual support. Trigger strategies are in equilibrium if the following threshold condition is fulfilled:

$$\zeta^* = \max(\zeta_A, \zeta_B) \leq w, \text{ with } \zeta_i = \frac{1}{\pi_i \eta_i + (1-\pi_j)}, \ \eta_i = \frac{b_i}{c_i} > 1, \ i = A, B. \tag{3.1}$$

According to the equilibrium condition, support between rational actors requires that a certain threshold is smaller than the continuation probability w. This threshold ζ^*, called *dyadic* threshold, depends on the costs (c_i), the benefits (b_i), neediness (π_i), and the continuation probability (w). Rational cooperation (mutual support) requires that *no* actor faces strong incentives to deviate from mutual support. Thus, both *individual* thresholds ζ_i have to be smaller than the continuation probability w, i.e., the dyadic threshold ζ^* has to be smaller or equal to the continuation probability w. The individual threshold ζ_i increases in the benefit-cost ratios η_i (i.e., increases in the costs and decreases in the benefits), and in neediness π_i. Note that the equilibrium condition depends on the benefits b_i and costs c_i only through the benefit-cost ratio η_i. From now on we therefore study heterogeneity in two parameters: the benefit-cost ratio η_i and neediness π_i.

3.2.3 Hypotheses

The equilibrium condition (3.1) states that there will be *no* support between people if the dyadic threshold ζ^* is larger than the continuation probability *w*, and that there will be full support if the dyadic threshold ζ^* is smaller than the continuation probability *w*. We do not expect such a sharp distinction empirically. First of all, it is not straightforward for subjects to compute the dyadic threshold. Second, subjects presumably do not play trigger strategies. For instance, occasional refusal of support may well be forgiven. And third, there is a difference between the prediction of the existence of an equilibrium at the *dyadic* level as stated in (3.1), and the prediction of how a person behaves in the decision situations at the *individual* level. We do not expect that people either provide full support or no support depending merely on whether a certain threshold is larger or smaller than a given continuation probability. We use the game-theoretic results heuristically and test less strict hypotheses. We expect *less* support between subjects, the *larger* ζ^* and the *smaller w* is. Keeping the continuation probability *w* fixed, ζ^* can be treated as an indicator for 'how likely social support is' between pairs of subjects.

Hypothesis 3.1 (dyadic threshold): *The larger the dyadic threshold* ζ^*, *the smaller the probability of providing support.*

The dyadic threshold ζ^* is a function of η_i and π_i. How does the dyadic threshold ζ^* depend on these parameters? The comparison of social support between heterogeneous actors with social support between homogeneous actors is not straightforward. We need a method to compare homogeneous and heterogeneous ISGs. One common method to do this is to keep the 'total amount' of the parameters for the benefit-cost ratio and for neediness constant and to study the consequences of varying the *distribution* of the parameters between the actors (constant sum condition). This resembles the distribution of a fixed amount of tangible resources between the actors. Similar approaches to study effects of 'inequality' can be found, for instance, in the literature on income inequality (e.g., Atkinson 1970, Sen 1997) and on insurance and uncertainty (Arrow 1951). Given the constant sum condition, the minimization of ζ^* is not equivalent with minimizing ζ_A and ζ_B at the same time. If ζ_A decreases, ζ_B necessarily increases. To simplify the presentation of the analysis we induce heterogeneity in the benefit-cost ratio η_i via the costs ($c_B > c_A$) and keep the benefits ($b_A = b_B$) homogeneous. We do not have a theoretical reason to vary the costs and fix the benefits. Our experimental design is merely based on the intuition that heterogeneity in the costs is more salient than heterogeneity in the benefits.

We now consider several heterogeneous and homogeneous distributions of the parameters. First, we address the situation with homogeneity in all parameters. It can be shown (see Appendix A) that, subject to a 'budget constraint', ζ^* is smallest under a homogeneous distribution of all parameters and equal individual thresholds ($\zeta_A = \zeta_B$).

Hypothesis 3.2 (homogeneity): *A homogeneous distribution of all parameters between the actors,* $\pi_A = \pi_B$ *and* $\eta_A = \eta_B$, *leads to optimal conditions of social support.*

Next, we consider heterogeneity in only *one* parameter, and homogeneity in the other. For example, B has higher support costs than A. Consequently, the support situation is 'more difficult' for B than for A. It can be shown that the dyadic threshold is larger under heterogeneity in *one* parameter than in the situation with equal costs. Thus, if $c_B > c_A$, ζ_B is larger than ζ_A, and $\zeta^* = (\zeta_A, \zeta_B)$ is larger than under $c_A = c_B$. Analogously, heterogeneity in neediness ($\pi_B > \pi_A$) hampers social support.

Hypothesis 3.3 (heterogeneity in one parameter): *The probability of providing social support is smaller under a heterogeneous distribution of one parameter than under a homogeneous distribution of all parameters. The more heterogeneous the distribution of one parameter, the less likely is social support.*

Now we allow heterogeneity in the benefit-costs parameter and neediness (η_i and π_i). We then have to differentiate two feasible situations. The first situation, labeled 'accumulation', is characterized by $(\pi_A - \pi_B)(c_A - c_B) < 0$. Given heterogeneity in one parameter, adding heterogeneity in another parameter makes social support even less likely than in a situation with heterogeneity in only one parameter. Assume again that providing support is more costly for B than it is for A. This already makes support more difficult for B. Now assume that at the same time, A needs support more often than B does. Thus, B is asked to provide support more often than A is, although it is more costly for B than for A to give support. Thus, B has two 'problems', namely high support costs and a very needy partner. The heterogeneous distribution of one parameter ($c_B > c_A$) 'accumulates' with the heterogeneous distribution of another parameter ($\pi_B < \pi_A$). Such an accumulatively heterogeneous distribution of two parameters leads to more heterogeneity in the individual thresholds ($\zeta_A > \zeta_B$) than a heterogeneous distribution of only one parameter, and consequently to a larger dyadic threshold ζ^*.

Hypothesis 3.4 (accumulation): *The probability of providing social support is smaller under a heterogeneous distribution of two parameters, such that the heterogeneity of one parameter accumulates with the heterogeneity of the other parameter, than under a heterogeneous distribution of one parameter. The more the heterogeneity of the two parameters accumulates, the less likely is social support.*

In a second class of situations, labeled 'compensation' and characterized by $(\pi_A - \pi_B)(c_A - c_B) > 0$, we consider heterogeneity in two parameters in which 'each actor has a problem'. For instance, B has higher support costs, but A needs support less often than B does. In this sense, the problems are 'divided' between B and A; B's problem is the high support costs, A's problem is that B is needier in comparison to him or herself. In other words, the heterogeneous distribution of the costs ($c_B > c_A$) compensates for the heterogeneous distribution of neediness ($\pi_B > \pi_A$). If the heterogeneous distributions of the two parameters compensate each other *optimally*, this leads to an equalization of the individual thresholds ($\zeta_A = \zeta_B$). Consequently, under optimal compensation ($\zeta^* = \zeta_A = \zeta_B$) ζ^* is less restrictive than under heterogeneity in one parameter ($\zeta^* = \max(\zeta_B > \zeta_A)$). Thus, we predict more support under optimal compensation than under heterogeneity in one parameter.

Hypothesis 3.5 (compensation): *The probability of providing social support is larger under a heterogeneous distribution of two parameters, such that the heterogeneity of one parameter optimally compensates for the heterogeneity of the other parameter, than under a heterogeneous distribution of one parameter.*

We want to stress that there exists an 'optimal degree of compensation'. Up to this level ('undercompensation'), the larger the compensation of the heterogeneity of the two parameters, the more social support there is. Above this level of heterogeneity ('overcompensation'), the compensation becomes less effective and consequently support starts to decrease again (see for numerical examples of the compensation and accumulation hypotheses the experimental design in Section 3.3.1).

For a formal proof of the hypotheses see Appendix A. In Section 3.3.2, we derive testable implications of the hypotheses. We use the experimental design (Section 3.3.1) to present these implications. The experimental conditions reflect the hypotheses and the testable implications.

3.3. Experiment

To test our hypotheses, we use data from a laboratory experiment, in which subjects played series of ISGs. We first introduce the experimental set-up in more detail. Subsequently, we discuss the statistical model and the empirical findings.[3]

[3] The English translation of the instructions for the experiment is found in Appendix B.

3.3.1 Design

General set-up of the experiment: A laboratory experiment with 148 subjects was carried out at Utrecht University, the Netherlands, in May 2004. Subjects played homogeneous and heterogeneous ISGs.

Subjects: Subjects participated in reaction to an advertisement inviting them to participate in a ‘decision-making experiment’. The advertisement promised them between 9 and 18 euros for participation. The number of subjects in one experimental session ranged from 14 up to 18 subjects. 68% of the participants were female. Most of the participants were students, coming from a variety of disciplines. Subjects were on average 22 years old (std. dev. 3.6).

Procedure: Upon entering the laboratory, subjects received a random number and were asked to take a seat behind the computer with the corresponding number. The subjects were at all times able to see each other to some extent. The experiment was to be partly completed by pen and paper, and partly by computer. The instructions were given on paper. The interactive part of the experiment and the questionnaires were done by computer. All subjects were given the same instructions. As a first task the subjects were asked to read the instructions. The experiment was conducted with the software program Z-Tree (Fischbacher 1999). The introduction to the instructions ended with three questions intended for testing the subjects’ understanding. The instructions emphasized that the payment at the end of the experiment would be in accordance with the decisions that subjects had made. For each point the subjects earned, they would receive one eurocent. It was explicitly mentioned that there were no ‘right’ or ‘wrong’ decisions. All references to heterogeneity were avoided. Subjects were told that they could interrupt any task at any time to ask the experimenter for assistance.

The subjects played series of ISGs with other subjects. In each ISG one subject was assigned the role of person A and the other subject obtained the role of person B. Subjects could not identify who the other person was with whom they were playing. Roles A and B can be homogeneous with respect to the benefit-cost ratio and neediness, or they can be heterogeneous. We present the experimental conditions in terms of the individual parameters of role A and role B in the next section. Which subject got which role was determined at random by the computer. For a period of 15 minutes, i.e. one *part* of the experiment, subjects played ISGs under one specific set of values for costs, benefits, and neediness (one experimental condition). Subjects were linked with a randomly selected other at the beginning of each ISG. Subjects may by chance have been assigned to the same role and partner in subsequent ISGs. However, they could not recognize their partner. The parameters remained the same within each separate part of the game, but they varied between the different parts. One single session was comprised of three different parts. Each subject participated in one session. The entire experiment contained nine sessions.

In each *decision situation* in an ISG, the subjects receive a certain amount of points (endowments). In one decision situation, either the A or the B subjects were ‘threatened’ to lose their endowments ('neediness'). The subjects not faced with a loss were asked to decide whether or not to prevent their partner from losing the full endowment. Note that for now, the subject in need is not presented with a decision. A threatened subject kept the entire endowment ('benefit') if his or her partner helped to overcome that threat. If a threatened subject did not receive help, then that subject lost the entire endowment in that particular decision situation. A subject who was not faced with a loss was given the decision either to help or not to help his or her partner. Helping was operationalized as giving away some of one's own costly endowments ('costs'). Subjects were not given the option to choose the number of points they gave up, neither were they allowed to choose the costs nor the benefits or the probabilities of being threatened to lose points. These parameters were fixed within one part of a session (see 'conditions' below).

The computer determined the duration of an ISG, i.e., how long two subjects were matched together. A number from 1 to 5 was chosen, each with equal probability. If 5 turned up the ISG ended. During the entire experiment, the same continuation probability of $\frac{4}{5}$ was used in all ISGs. Changing partners was a necessity, but changing roles was not.

A session started with four practice decision situations (for a discussion on the effects of experience with the decision situation, see, e.g., Camerer and Weigelt 1988). Subjects were informed during the practice rounds that they were playing against the computer and that they could not earn money.[4]

Questionnaire: After playing the games, subjects filled in a questionnaire on a number of basic demographics and they were asked to evaluate a number of statements on trust, reciprocity, support, giving and receiving compliments, empathy, giving and denying help, etc. In total the experiment took between 70 and 90 minutes.

Conditions: The experiment varied the costs of providing support (c_A, c_B) and the probabilities of needing support (π_A, π_B) between two subjects playing an ISG and between the conditions. The benefits did not vary between subjects ($b_A = b_B$), but the benefits varied between conditions. This was done in order to obtain appropriate numbers for the benefit-cost ratio. It suffices to test the hypotheses by varying these two parameters between subjects. In each part of the experiment, subjects played support games with the parameters as they are used in one of the nine conditions displayed in Table 3.1.

[4] The practice rounds were designed in such a way that both the computer and the subjects were threatened twice with a loss of points. In the cases where the subjects were threatened to lose points, the computer 'provided support' once, and did 'not provide support' once. The practice round was a game under heterogeneity in probabilities and costs.

Table 3.1 Experimental design.

Condition Description	Parameters π_A	π_B	c_A	c_B	$b_A = b_B$	Thresholds ζ_A	ζ_B	ζ^*
Homogeneity in all parameters:								
C_1: $\pi_A = \pi_B$, $c_A = c_B$	0.5	0.5	8	8	24	0.50	0.50	0.50
Heterogeneity in one parameter:								
C_2: $\pi_A = \pi_B$, $c_A < c_B$,	0.5	0.5	8	16	32	0.40	0.67	0.67
C_3: $\pi_A = \pi_B$, $c_A << c_B$	0.5	0.5	8	24	36	0.36	0.80	0.80
C_4: $\pi_A > \pi_B$, $c_A = c_B$	0.6	0.4	8	8	24	0.42	0.63	0.63
C_5: $\pi_A >> \pi_B$, $c_A = c_B$	0.7	0.3	8	8	24	0.36	0.83	0.83
Heterogeneity in two parameters:								
'Accumulation'								
C_6: $\pi_A > \pi_B$, $c_A < c_B$	0.6	0.4	8	16	32	0.33	0.83	0.83
C_7: $\pi_A > \pi_B$, $c_A << c_B$	0.6	0.4	8	24	36	0.33	1.00	1.00
'Compensation'								
C_8: $\pi_A << \pi_B$, $c_A < c_B$	0.3	0.7	8	16	32	0.67	0.48	0.67
C_9: $\pi_A << \pi_B$, $c_A << c_B$	0.3	0.7	8	24	36	0.61	0.57	0.61

The rows specify the nine conditions of the experiment, the individual thresholds ζ_i, and the dyadic threshold ζ^* as derived from our game-theoretic model (assuming 'own points match utility'). Consider, for instance, C_9. Subjects in role A need support with probability $\pi_A = 0.3$. The costs of providing support in role A are $c_A = 8$ points, and the benefits of role A are $b_A = 36$ points. Subjects in role B need support with probability $\pi_B = 0.7$, thus much higher than the probability of role A. The costs of providing support are $c_B = 24$ points for role B. This is three times more than the costs for role A. The benefits are the same for roles A and B, namely $b_A = b_B = 36$ points. In accordance with the equilibrium condition (Section 3.2.2), these parameters lead to the individual thresholds $\zeta_A = 0.61$ and $\zeta_B = 0.57$, and to the dyadic threshold $\zeta^* = \max(\zeta_A, \zeta_B) = 0.61$. The nine conditions satisfy the constant sum condition $\pi_A + \pi_B = 1$ and $\frac{b_A}{c_A} + \frac{b_B}{c_B} = 6.$ One aim of the design was to obtain maximal variation in the dyadic thresholds. However, we did not want to vary neediness too much, since we wanted to avoid situations in which one actor almost permanently needs support.

The nine experimental conditions can be grouped in the following way. The first condition, C_1, uses a homogeneous distribution of the costs and the benefits. The next four conditions (C_2, C_3, C_4, C_5) specify 'small' and 'large' heterogeneity in one parameter, i.e., either in the costs or in neediness. The last four conditions specify heterogeneity in the costs and in neediness, first in an accumulative way (C_6, C_7) and then in a compensative way (C_8, C_9).

The experiment contained the following sessions: (1) $C_1 - C_6 - C_9$, (2) $C_7 - C_5 - C_2$, and (3) $C_8 - C_3 - C_4$. The design of the experiment was a *within* and *between* subjects design. Due to computer network problems, and consequently time problems, we could not complete the third part in two sessions, which means we have less data on the conditions C_2 and C_9.

3.3.2 A Comparison of the Experimental Conditions

We now consider the nine conditions in more detail, and discuss the implications of the Hypotheses 3.2 until 3.5; we compare the percentages of support (P_1 – P_9) under the experimental conditions (C_1 – C_9). The first condition C_1 specifies a fully homogeneous situation in costs (c) and neediness (π). A totally homogeneous distribution of the individual parameters between actors leads to the smallest threshold. Based on Hypothesis 3.3 ('heterogeneity in one parameter') we consequently predict more support under C_1 than under any other condition (C_2 through C_9):

Comparison 1: $P_1 > P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9$.

Conditions C_2 to C_5 involve heterogeneity in either the costs or neediness parameters and homogeneity in the other parameters. The two conditions C_2 and C_3 specify heterogeneity in the costs (c). The heterogeneity in the costs is larger under C_3 than in C_2. Similarly, the conditions C_4 and C_5 specify heterogeneity in neediness with larger heterogeneity under C_5 than under C_4. We predict that heterogeneity in either costs or neediness hampers social support and that a larger heterogeneity hampers support even more:

Comparison 2: $P_2 > P_3, P_4 > P_5$.

In the remaining four conditions (C_6 to C_9), we induce heterogeneity in both the costs *and* neediness. First, we induce heterogeneity in such a way that the heterogeneity in both parameters accumulates. Under C_6 actor A needs support more often than actor B (0.6 > 0.4), while actor B has the higher support costs (16 > 8). Thus, A is in 'trouble', and we expect a very low support rate. The same holds for C_7. In Hypothesis 3.4 ('accumulation') we predict that a situation with two problems for one actor leads to less support than a situation with one problem for one actor. Comparing situations with heterogeneity in one parameter with situations with accumulative heterogeneity in two parameters, we predict more support in situations with heterogeneity in either costs or neediness (C_2, C_3, C_4) than in situations with accumulative heterogeneity in costs and neediness (C_6, C_7):

Comparison 3: $P_2 > P_6, P_4 > P_6, P_3 > P_7, P_4 > P_7$.

Under C_7 we have a higher degree of heterogeneity in the costs (24 > 8) than under C_6 (16 > 8), while the heterogeneity in neediness is the same, i.e., the accumulation of the heterogeneity in costs and neediness is larger under C_7 than C_6. Consequently, we predict more support under C_6 than under C_7:

Comparison 4: $P_6 > P_7$.

Under the last two conditions (C_8 and C_9) the heterogeneous distribution of one parameter (c) is compensated by the heterogeneous distribution of another parameter (π); role B has higher support costs than role A, but role A needs support less often than role B. Now the two problems caused by heterogeneity are divided between the two actors. Under condition C_9 the heterogeneous distribution of the costs is even more extreme than under condition C_8. It is interesting that larger heterogeneous costs compensate for the heterogeneity in neediness even 'better' than smaller heterogeneity in the costs do. This is reflected in the dyadic thresholds of the conditions C_8 and C_9 (0.67 > 0.61). Based on Hypothesis 3.5 ('compensation'), we predict more support under the 'better' problem division of C_9 than under C_8.

Comparison 5: $P_9 > P_8$.

The experimental design does not include *optimal* compensation. Consequently, we cannot compare optimal compensation of heterogeneity in two parameters with heterogeneity in one parameter. Compensation that is not optimal does not necessarily lead to a smaller ζ^*, and thus to a higher support rate than heterogeneity in one dimension. As numerical example, compare C_2 and C_8; in both conditions the dyadic threshold is $\zeta^* = 0.67$. Furthermore, the experimental design does not allow us to compare the predictions based on Hypothesis 3.4 ('accumulation') with predictions based on Hypothesis 3.5 ('compensation'), because we did not merely 'reverse' the actors' neediness from the accumulative situation to the compensative situation.

3.3.3 Statistical Model

The following section discusses statistical tests of our hypotheses and testable implications. The data are analyzed from the perspective of the actor faced with the choice of providing support to the other actor (we call this actor Ego), thus the binary dependent variable is whether or not Ego provides support. The theoretical analysis assumes complete information and is not appropriate for deriving realistic hypotheses about behavioral dynamics. To exclude common history effects we restrict our analysis to the first decisions in the ISGs.

A subject's decision to either provide or not to provide support is the outcome of a discrete choice. To make an estimation of the first decisions in a single ISG, one would normally use an ordinary logit or probit regression model. But this is not appropriate, since the ISGs are repeated *within* subjects. Therefore, we use an extension of the logistic regression model that incorporates random or fixed subject effects, the Linear Logistic Test Model (LLTM, see Fischer 1997: 226-27).

The starting point in formulating the statistical model is the simple Rasch model of item response theory. The Rasch model involves 'difficulties' of the items (decision situations) and individual abilities. With the LLTM we model the choices of subjects in a similar way. Subject i's decision whether to provide support ($y_i = 1$) or not to provide support ($y_i = 0$) is assumed to depend on the difference between i's personal parameter o_i, representing a person's 'general willingness' to provide support, and a parameter ϑ_r, representing the situation in which the person made his or her decision:

$$\pi_{irh} = \Pr(y_{irh} = 1 | o_i, \vartheta_r) = \frac{e^{o_i - \vartheta_r}}{1 + e^{o_i - \vartheta_r}},$$

where r indexes conditions and h indexes repetition, i.e., playing ISGs with different partners, within each condition r. Our hypotheses are formulated as assertions about differences in support behavior between the experimental conditions. The item parameter ϑ_r is decomposed as:

$$\vartheta_r = \sum_{k=1}^{m} \beta_k z_{kr},$$

where z_{kr} are characteristics of experimental conditions and β_k are the parameters to be estimated. We use a *random* effects specification for the subject parameter, and estimate the model with marginal maximum likelihood. We present two models. The first model 'explains' differences in the support rates of conditions C_1 to C_9 with the dyadic threshold ζ^* as hypothesized in Hypothesis 3.1. In the second model, we estimate the simple Rasch model in which each condition is represented by a dummy. This specification allows us to test the ranking of the nine conditions (based on Hypotheses 3.2 to 3.5) without the strong assumption that the support rates are a smooth function of ζ^* (see Section 3.3.2).

3.4 Results

First we present a number of descriptive results of the experiment. Subjects played on average 4.8 ISGs per part (std. 3.0). Per ISG 4.5 decisions were made on average (std. 3.6). Table 3.2 displays the percentages of support provided in the first round of each ISG. Our theoretical model does not predict a difference in behavior between roles A and B, since the same dyadic threshold ζ^* holds for both. We will review this expectation at the end of this section. The percentages of support provided under each condition are not in strict accordance with our hypothesis that the support rate is higher, the smaller the dyadic threshold (Hypothesis 3.1); the largest percentage of support is not found under a homogeneous distribution of all parameters as predicted by the threshold model C_1 (ζ^* = 0.50). There is, e.g., more support under C_7 (ζ^* = 1.00) than under C_9 (ζ^* = 0.61).

Table 3.2 Percentage of support in the first round of the ISGs (N = number of decisions).

Condition description	A & B : support round 1	N	ζ^*	A : support round 1	N	ζ_A	B : support round 1	N	ζ_B
C_1: Homogeneity	72	145	0.50						
C_2: Small heterogeneity in costs	54	58	0.67	64	28	0.40	43	30	0.67
C_3: Big heterogeneity in costs	58	144	0.80	76	75	0.36	39	60	0.80
C_4: Small heterogeneity in neediness	79	121	0.63	79	43	0.42	78	78	0.63
C_5: Big heterogeneity in neediness	65	159	0.83	86	70	0.36	49	89	0.83
C_6: Small accumulation	40	117	0.83	59	51	0.33	26	66	0.83
C_7: Big accumulation	61	170	1.00	77	48	0.30	55	122	1.00
C_8: Small compensation	77	66	0.67	79	42	0.67	75	24	0.48
C_9: Big compensation	56	45	0.61	74	27	0.61	28	18	0.57

We now focus on Hypothesis 3.1 ('dyadic threshold') based on the ISG, see Table 3.3. We hypothesize that supportive behavior decreases monotonically with the dyadic threshold ζ^*. We fitted a linear and a quadratic model in ζ^*; the simpler linear model fits equally well (see Table 3.3, LR $\chi^2(1) = 1.48$, *p-two-sided* = 0.2241). As predicted, the effect of ζ^* on the probability of support is negative. In this sense, our hypothesis is confirmed. To evaluate whether the threshold model really fits the data, we also fitted a saturated model in which dummy variables represent the experimental conditions. We had hoped that the threshold model fit as well as the saturated model. This turns out not to be the case (LR $\chi^2(7) = 21.35$, $p = 0.0033$). We conclude that we need to be cautious in our interpretation of the positive support for the hypothesis that support decreases in the dyadic threshold. We do not control for experiences subjects have from previously played ISGs.

Table 3.3 Random effect logistic regression for first choices in ISGs.

	Threshold Model		Saturated Model	
	coef	se	coef	se
Dyadic threshold ζ^*	-2.452	0.606		
Constant	2.549	0.480		
C_1: Homogeneity			1.425	0.293
C_2: Small heterogeneity in costs			0.066	0.372
C_3: Big heterogeneity in costs			0.483	0.263
C_4: Small heterogeneity in neediness			1.548	0.338
C_5: Big heterogeneity in neediness			0.502	0.286
C_6: Small accumulation			1.018	0.276
C_7: Big accumulation			-0.450	0.301
C_8: Small compensation			1.302	0.401
C_9: Big compensation			0.349	0.435
SD of subject	1.350		1.351	
SD of decision	$\sqrt{\frac{\pi^2}{3}}$		$\sqrt{\frac{\pi^2}{3}}$	
Loglikelihood	-601.863		-591.189	
Number of decisions	1025		1025	
Number of subjects	148		148	

Based on the Hypotheses 3.2 until 3.5, we derived a series of testable implications about the ranking of the support rates of the nine experimental conditions (see Section 3.3.2). Table 3.4 reports Wald tests of the predictions, based on a simple random effects Rasch Model.

Hypotheses 3.3 states that support is less likely under heterogeneity in one parameter than under full homogeneity. Thus, in Comparison 1 we compare the percentages of support under full homogeneity (C_1) with the percentages of support under conditions of heterogeneity either in the costs (C_2 and C_3) or in neediness (C_4 and C_5). We find a significant difference in the predicted direction in behavior between homogeneity (C_1) on the one hand, and heterogeneity in costs (C_2, C_3), as well as large heterogeneity in neediness (C_5) on the other hand. We do not find a significant difference between the percentages of support under homogeneity (C_1) and small heterogeneity in neediness (C_4).

In Comparison 2, we predict that the more heterogeneous the distribution of costs or neediness, the less likely social support. Thus, we compare small heterogeneity in neediness with large heterogeneity in neediness, and small heterogeneity in the costs with large heterogeneity in the costs. As expected, a small heterogeneity in neediness (C_4) leads to a higher support rate than a large heterogeneity (C_5). For costs, the difference between a small heterogeneity (C_2) and a large heterogeneity (C_3) are not found.

Hypotheses 3.4 states that heterogeneity in two parameters leads to less support if the heterogeneity accumulates, such that one actor has larger costs and smaller neediness, than heterogeneity in one parameter. Thus, in Comparison 3 we compare the percentages of support under heterogeneity in one parameter (C_2, C_3, C_4) with the percentages of support under accumulative heterogeneity in two parameters (C_6, C_7). The hypotheses are partly confirmed. We find significant differences in supportive behavior in three cases. First, people become less supportive if they differ largely in the costs (C_3) and a small difference in neediness (C_7) is added. Second, the percentage of support is significantly reduced if, in addition to a small heterogeneity in neediness (C_4), a large heterogeneity in the costs (C_7) is added, such that the less needy person has higher support costs. We do not find a significant effect on supportive behavior if a small heterogeneity in the costs (C_6) is added to a small heterogeneity in neediness (C_4) accumulatively. We predict less support if a small heterogeneity in neediness (C_6) is added to a small heterogeneity in the costs (C_2) accumulatively. This prediction is rejected by the data. Additionally, we predicted that support is less likely the larger the accumulation in the costs and neediness (Comparison 4). We find that people tend to provide less support if they already differ with regard to costs and neediness in an accumulative way (C_6) and the heterogeneity in the costs increases in such a way that the accumulation becomes larger (C_7).

Based on Hypotheses 3.5, we expect more support the ‘better’ the problems are divided between the actors, i.e., the better the heterogeneity is compensated. Since the heterogeneity is ‘better’ compensated under C_9 than under C_8, we expect $P_9 > P_8$. This is rejected by the data (Comparison 5). Our experimental design does not allow for a comparison of compensation with heterogeneity in one dimension. Therefore, we cannot test the entire hypothesis.

According to Hypothesis 3.2 (‘homogeneity’), social support is most likely if all parameters are homogeneous (Comparison 1). This is largely confirmed, though in some cases the difference in supportive behavior is not significant. The latter case consists of the situations with *small* heterogeneous distributions such as small heterogeneity in neediness (C_4), small accumulation of heterogeneity in neediness and in the costs (C_6), and small compensation in the heterogeneity in the costs and neediness (C_8) – except for small heterogeneity in the costs (C_2).

Generally spoken, behavior does not seem to be influenced if a *small* problem is added to an actor already facing a small problem (accumulation), or to an actor who does not have a problem. However, if a large problem is added, there is a significant difference in the behavior of the subjects in the expected direction. This suggests that the 'small effects' are not found to be mostly due to a lack of power. Unfortunately, our design does not allow for a comparison of situations where heterogeneity in two parameters compensates for a situation where heterogeneity in two parameters accumulates.

Table 3.4 Test of qualitative predictions on supportive behavior per condition.

	Wald z	one sided p-value	
Hypothesis 'heterogeneity in one parameter'			
Homogeneity versus heterogeneity			
$P_1 > P_2$	2.87	0.002	☝
$P_1 > P_3$	2.55	0.011	☝
$P_1 > P_4$	-0.28	0.612	*nc*
$P_1 > P_5$	2.26	0.024	☝
Small versus large heterogeneity			
$P_2 > P_3$	-0.91	0.820	*nc*
$P_4 > P_5$	2.37	0.009	☝
Hypothesis 'accumulation'			
Heterogeneity in one parameter versus accumulation			
$P_3 > P_7$	2.33	0.010	☝
$P_4 > P_7$	4.41	0.000	☝
$P_4 > P_6$	1.26	0.105	*nc*
$P_2 > P_6$	-2.05	0.980	☟
Small versus large accumulation			
$P_6 > P_7$	3.59	0.000	☝
Hypothesis 'compensation'			
Small versus large compensation			
$P_9 > P_8$	-1.62	0.948	☟

☝: confirmed; ☟: rejected; *nc*: not confirmed.

Before we conclude, we would like to address one more issue. According to the dyadic threshold model we did not expect a difference in the behavior of role A and role B. Based on the logic of trigger strategies in ISGs, we argue that both players provide support if and only if it is individually rational for both players to do so (dyadic threshold). If it is not in B's interest to offer support, A will recognize this and will offer no support either. Consequently, both actors either provide support or do not provide support. However, under certain conditions one partner faces problems such as high support costs, whereas the other person faces no problems at all, or 'small' problems only. Intuitively, one might expect different behavior of these two persons, namely that the person with the higher support costs provides support less often than the person with the lower support costs. That is, individual behavior may well depend on the individual thresholds directly. This can be related to bargaining solutions and to other equilibria of the theory of repeated games. Based on Table 3.2 we suspect that the behavior of subjects in roles A and B indeed differ, namely such that the lower the individual threshold, the more an actor provides support. To test this, we fitted an additional model which is saturated with respect to conditions and to role.[5] A test against model 2 of Table 3.2 demonstrates that behavior does indeed vary with role (LR χ^2 (8) = 96.91, p < 0.000). This implies that our theoretical model could be improved by relaxing certain assumptions, such that a threshold for both actors (dyadic threshold) does not follow. This is elaborated in the discussion.

3.5 Conclusion and Discussion

In this chapter, we have argued that the effects of heterogeneity on social support can be conveniently studied in terms of exchange of social support with heterogeneity conceptualized as differences between actors with respect to the costs of providing support, the benefits from receiving support, and the likelihood of needing support. The dyadic support relation has been modeled as an ISG. According to the theoretical analysis, social support is most easily attained under a fully homogeneous distribution of the individual parameters. If there is heterogeneity in at least one parameter, social support is less likely than under homogeneity. However, heterogeneity in one parameter can be compensated by the heterogeneity of the other parameter. Intuitively, actors ‘share’ the burden of two problems. Heterogeneity in two parameters can also be allocated in such a way that one actor is faced with both problems. In such a situation, we say that the heterogeneity in one parameter ‘accumulates’ with the heterogeneity in the other parameter. It is important to be aware that ‘homogeneity is globally best’ does not mean that ‘less heterogeneity’ between actors necessarily leads to more social support than ‘more heterogeneity’. Heterogeneity decreases if the distribution of any of the parameters is made more equal. However, if such a reduction in heterogeneity is performed in a parameter that was skewed to compensate for heterogeneity in another parameter, the compensation effect will become smaller, and so social support will be hampered, not facilitated.

We hypothesized that supportive behavior depends monotonically on the dyadic threshold. Tests have shown that the saturated model fitted the data considerably better than the linear model of the dyadic threshold. We are therefore reluctant in concluding that social support is more likely the smaller the dyadic threshold. More satisfying are the tests of the qualitative predictions. We found that small heterogeneity does not seem to matter considerably; only large heterogeneity leads to different behavioral consequences. Supportive behavior in homogeneous situations differs significantly from supportive behavior in situations with large heterogeneity in one parameter. In line with this, we also found that if

[5] Obviously, under homogeneous roles, A and B do not differ. Therefore, the test has 8 degrees of freedom.

heterogeneity increases, social support is less likely. The only two exceptions are the comparison of small heterogeneity in the costs with small accumulation, as well as large and small compensation, which turned out to be nonsignificant.

Finally, we wish to discuss one additional point with respect to the ISG. Our analysis has shown that the assumption that both actors provide support only if it is individually rational for both of them (threshold condition) is not appropriate; subjects in role A behave different from subjects in role B. This allows us to study heterogeneity in terms of *roles*. Intuitively, one could expect an actor facing one or two problems to behave differently from an actor who is not facing any problems. The data indicate that subjects in the 'strong' role generally provide support more often than subjects in the 'weak' role. One explanation might be that subjects follow certain *fairness* principles; the 'strong' actors may be willing to provide support more often so that both actors receive the same outcome. If fairness matters, actors compare their own outcome and the outcome of their partner with a 'fair share'. Incorporating fairness would allow for an analysis of the full history of ISGs under the assumption that actors 'maximize fairness'. Fairness principles can be derived, for instance, from equity theory or from bargaining theory (see Weesie 2005).

Chapter 4

Social Support in Opportunity and Threat Situations*

Abstract

This chapter studies whether social support is more easily given in situations where Ego has the choice to provide support to Alter to enable Alter to seize an *opportunity of a gain* or alternatively, in situations where Ego may support Alter to prevent a *threat of a loss*. The chapter, furthermore, analyzes how individual differences with respect to risk preferences affect decisions in opportunity and threat situations. The underlying game-theoretic model of support allows heterogeneity between the actors with respect to the *likelihood of needing support*. This allows us to study additionally whether the effects of risk preferences in opportunity and threat situations differ with heterogeneity in the likelihood of Ego and Alter needing support. We hypothesize that risk averse/seeking subjects are more/less likely to provide support in threat than in opportunity situations. Subjects with S-shaped utility with loss aversion are more likely to provide support in threat situations, whereas subjects with S-shaped utility without loss aversion, as well as subjects with risk neutral utility do not differ in their behavior in threat and opportunity situations. The hypotheses have been tested by a laboratory experiment. The hypotheses on the effects of risk preferences on supportive behavior in opportunity and threat situations have not been confirmed. The effect of heterogeneity has only partially been confirmed.

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* This chapter is co-authored with Jeroen Weesie and Werner Raub.

4.1 Introduction

In this chapter we compare whether social support is more easily given in 'opportunity' or in 'threat' situations. David can lend money to Maria in order for her to seize an opportunity, namely to get a loan to buy something. Alternatively, he may prevent a threat to Maria, namely to pay a dept that she has in order to overcome higher interest rates. We are interested under which circumstances David is more likely to provide support: to seize an *opportunity* of an additional *gain* for Maria, or to prevent a *threat* of a *loss* to Maria? We focus on durable relations between two people that are occasionally in need of support of each other; Maria may be in need of support from David today, but David may find himself in need of support from Maria tomorrow.

Furthermore, we are interested in how individual differences with respect to risk preferences affect decisions in these different structural conditions. Research on individual decision making has shown intrapersonal differences in evaluating outcomes of a loss ('threat situation') and of a gain ('opportunity situation') (see for an overview Kahneman and Tversky 2000). Assuming that the amount of money involved in both examples is the same, *risk neutral* subjects evaluate both situations in the same way. Thus, their choice whether or not to provide support would not differ between the two situations. Some subjects are risk averse, others are risk seeking. Kahneman and Tversky (1979) suggest that subjects are risk averse for gains and risk seeking for losses. Since subjects with non-linear utility functions evaluate the situations differently, the choice to provide or not to provide support depends on risk preferences too. For those subjects it matters whether they lend money to someone to seize an opportunity or to overcome a threat (e.g., Raub and Snijders 1997).

In former chapters, we have studied a game-theoretic model of social support, the Iterated Support Game (ISG), to study whether support is more likely among *homogeneous* or *heterogeneous* actors (Chapters 2 and 3). Heterogeneity has been defined in terms of the *likelihood of needing support* (or in terms of other aspects such as costs of providing support, benefits from receiving support, discount rates, etc). We consider heterogeneity in the likelihood of needing support as a '*structural'* (non-psychological) individual property. The ISG is studied again in this chapter. Since we are interested to learn more about the consequences of heterogeneity we investigate whether the effects of risk preferences differ with regard to heterogeneity in the likelihood of needing support among the actors.

Sociological research mostly focuses on structural conditions. Why then are we interested in the effects of *psychological* individual properties, such as risk preferences, that are mainly studied in psychology and decision theory rather than in sociology? It would not be sufficient to claim that psychological individual properties have an effect in addition to structural conditions on social support. 'Explaining variance' is not interesting per se. However, sociologists should be interested in such 'psychological' properties if social conditions have different effects for different kinds of people, i.e., if there is an interaction effect between psychological individual properties and the structural social conditions. In this chapter we argue that an interaction between risk preferences, threats versus opportunities, and heterogeneity in the likelihood of needing social support is indeed to be expected. We derive and test hypotheses on subjects' decisions whether to provide or not to provide support in opportunity and in threat situations for different types of risk preferences. We furthermore derive hypotheses on how the effect of heterogeneity in the likelihood of needing social support in opportunity and threat situations differs with risk preferences, and a 3-way interaction between two structural properties (opportunity/threat and homogeneity/ heterogeneity in neediness) and one individual property (risk preference).

4.2 Social support between Heterogeneous Actors

4.2.1 A Model of Support

We study social support in durable relationships between two actors (see for social support, for instance, Homans 1958, 1961, Blau 1964, 1968, Molm 1990). Social support in a dyadic relation is first presented as a *one-shot* support game with two actors A and B (for a detailed discussion see Chapter 2). We assume that at each time point (t = 1, 2, …) one actor is in need of support; either actor A or actor B needs support with the likelihood of i needing support denoted by π_i, with i = A or B, and $\pi_A + \pi_B = 1$. From now on π_i will be called i's 'neediness'.[1] Actors may be *heterogeneous* with respect to neediness ($\pi_A \neq \pi_B$). The actor who is not in need of support can support the needy actor. Providing support is costly ($\overline{c}_i$), whereas receiving support is beneficial ($\overline{b}_i$). We use the notation with bars to distinguish costs of providing support and benefits from receiving support in outcome units from utility differences that are introduced later.

Note that we assume that both actors are occasionally in need of support and both actors can occasionally provide support: Today actor A needs support from actor B, however, tomorrow actor B might be in need of support from actor A. Thus, the decision of actor B to support or not to support actor A is based on the assumption that actor B knows that he could find himself in need of support from actor A in the future. Let us consider the situation wherein A needs support. If A does not get support, her outcome is x_A. If A needs support and receives support, her outcome is $x_A + \overline{b}_A$, so the additional gain she receives is the benefit $\overline{b}_A$. Actor B, who is *not* in need of support, can decide to support or not to support actor A. If actor B does not support actor A, the outcome for B is y_B. If actor B does provide support, it is costly for him and his outcome is $y_B - \overline{c}_B$, with $\overline{c}_B$ being B's costs of providing support expressed in outcome units. The alternative situation that B needs support is analogously, as seen in Figure 4.1:

[1] We assume that there is always one actor in need of support. This is done in order to keep the experimental test simpler. The analysis holds true if $\pi_A + \pi_B < 1$, i.e., if actors are occasionally in need (see for a proof Appendix A).

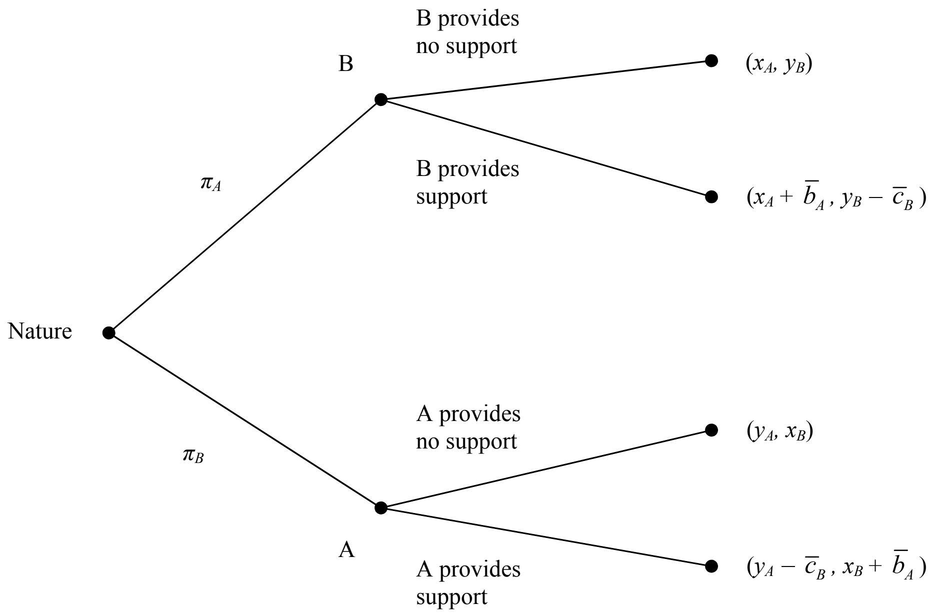

Figure 4.1 Extensive form of the Support Game (SG) in outcome units. The ISG is an iterated version of this game over time.

We assume that for both actors $\bar{b}_i > \bar{c}_i > 0$, i.e., the benefits of support received are larger than the costs of support given. The game is played non-cooperatively in the standard game-theoretic sense that actors are unable to make enforceable agreements or commitments. Now, both actors have an incentive not to provide support, although they would like to receive support in this one-shot game. There is a unique (subgame-perfect) Pareto inefficient Nash equilibrium in the one-shot game such that both actors do not provide support.

We are interested in studying social support not in one-shot encounters, but rather in *durable* relations in which at each time t either A or B is in need, and the other actor has to decide whether to give support. In a durable relation, support can be based on the strategic argument that actor A can threaten actor B with a refusal of support after actor B did not support actor A, while actor A can promise to provide actor B with support after actor B provided actor A with support. This mechanism is known as 'conditional cooperation' (e.g., Axelrod 1984). Both actors would be better off by providing and receiving support than by not providing and not receiving support at all, provided that

$$\frac{\bar{c}_A}{\bar{b}_A} < \frac{\pi_A}{\pi_B} < \frac{\bar{b}_B}{\bar{c}_B},$$

which we will assume to be the case. In contrast to the one-shot support game, the ISG continues after every decision round with a certain continuation probability w, with $0 < w < 1$. If the common future w is 'long enough', support may be provided by rational actors (for a detailed discussion of how 'long enough' varies with the individual parameters see Chapter 2).

4.2.2 Structural Conditions

We now study the outcomes of the ISG in threat and in opportunity situations. The outcome y_i of 'neither needing support oneself nor providing support' does not differ between threat and opportunity situations. In both situations, actor *i* has no benefits and no costs. We take this outcome as the *status quo* outcome. The outcome $y_i - \overline{c}_i$ of 'neither needing support oneself, while providing support' does not differ between opportunity and threat situations either; *i* has no (direct) benefits, but does incur costs of provided support. However, the outcomes 'needing and receiving' and 'needing and not receiving' differ between opportunity and threat situations. In case of a threat, the outcome 'needing and receiving support', $x_i + \overline{b}_i$, does not make *i* better or worse off than the status quo y_i. Thus, in threat situations the outcomes $x_i + \overline{b}_i$ and y_i, can be assumed to be equivalent. On the other hand, the outcome of 'needing and not receiving support' x_i is *below* the status quo in threat situations, i.e., *i* does not overcome a threat. In an opportunity situation, however, the outcome of 'needing and not receiving support', x_i, is equivalent to the status quo outcome y_i, i.e., *i* not realizing an *additional* gain is just the same to *i* as a situation in which *i* has no opportunity to do so. Now, the outcome of 'needing and receiving support', $x_i + \overline{b}_i$, is *above* the status quo. Here, *i* realizes the *additional* gain. Thus, there is a *structural* difference between social support to prevent a threat and social support to seize an opportunity: in *threat* situations we have $y_i = x_i + \overline{b}_i$, and for in *opportunity* situations we have $y_i = x_i$.

If we assume that $y_i = x_i + \overline{b}_i$ in a threat situation, we implicitly assume that actors who are threatened by a loss and overcome the threat have no costs themselves. Effectively, actor *i* has a problem that actor *j* can solve, and that actor *i* himself can do nothing about it. Something similar holds for the assumption that $y_i = x_i$ in opportunity situations. Due to this simplifying assumption, support does not involve any costs for the person who receives support. We are aware that this is not always reasonable. If farmer A needs help from farmer B because A's dikes are going to break, rebuilding the dikes requires work for both, not just for B. The same holds true if farmer A needs help from farmer B to seize the opportunity to build a new garage that he can only do jointly. However, if social support is understood more in terms of 'favor giving', the costs for receiving support are minimal. If farmer A goes on holiday and asks farmer B to feed his cows during that time, no costs for A are involved, however, for B helping is costly. Our introductory example of receiving monetary support from a friend hardly implies costs for the person being helped either. We therefore assume that receiving support does not imply any (short-term) costs, whereas providing support does imply such costs. To study the effects of risk preferences on support we need to compare outcomes that represent gains and outcomes that represent losses (risk preferences are discussed in detail in Section 4.2.3). To compare gains and losses of opportunity and threat situations we define a *reference point*, namely the status quo. Assuming that $y_i = 0$, we see that all outcomes of the *threat* situation are smaller or equal zero, providing that first, support leads to a negative outcome due to the support costs ($-\bar{c}_i < 0$); second, receiving support leads to the same outcome as not being threatened and not providing support and is by assumption equal to zero ($x_i+\bar{b}_i = y_i = 0$); and finally, being threatened and not receiving support leads to a certain loss ($x_i = -\bar{b}_i < 0$). Thus, the threat situation has two zero and one negative outcome.

The *opportunity* situation is a situation with mixed outcomes. Providing support leads to a negative outcome due to support costs ($-\bar{c}_i < 0$). But having the opportunity of an additional gain and realizing this opportunity leads to a positive outcome ($\bar{b}_i > 0$). And the outcomes of 'not realizing the opportunity' and 'not having the opportunity and not giving support' are the same and by assumption equal to zero ($x_i = y_i = 0$). Thus, we end up with a 'mixed' game with one zero, one positive, and one negative outcome. Since providing support in the ISG always implies certain costs for the person who provides support, we do not think of social support as a game with only positive outcomes as realistic. The structural difference between threat and opportunity situations can be seen in the subgames of the model of support in Figure 4.2 below (compare with Figure 4.1). The two subgames of the ISG presented in Figure 4.2 are templates for the experimental tests (discussed in Section 4.4).

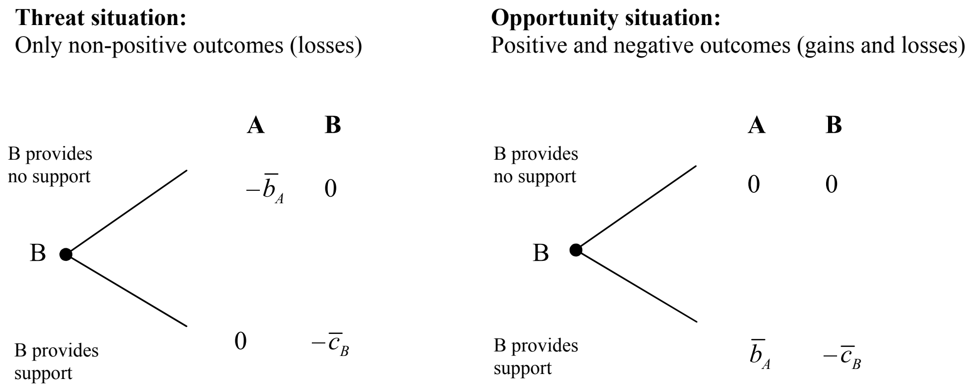

Figure 4.2 Subgames of 'opportunity' and 'threat' situations (from B's decision position whether or not to support A).

4.2.3 Risk Preferences and Expectations

So far we defined the games in terms of outcomes (such as money received) and avoided talking about the utilities that are associated with these outcomes. This is where risk preferences come in. If we assume that actors are rational in the sense of Expected Utility Theory as formulated by Von Neumann and Morgenstern (1944), risk preferences are related to the shape of the underlying utility function mapping outcomes of utilities. Risk neutrality corresponds with a *linear* utility function, risk aversion then corresponds with a *concave* utility function, and risk seeking corresponds with a *convex* utility function. Thus, subjects with risk averse preferences for gains and losses (i.e., globally risk averse utility) have by definition concave utility functions with decreasing marginal utility. Subjects with risk seeking preferences for gains and losses (i.e., globally risk seeking utility) have convex utility functions with increasing marginal utility. Some scholars have suggested that risk preferences may be different for gains and losses. Subjects with S-shaped utility functions have concave utility functions for gains, and convex utility functions for losses (Tversky and Kahneman 1992, Camerer and Ho 1994, Wu and Gonzalez 1996, Fennema and Van Assen 1999, Gonzalez and Wu 1999, Van Assen 2001, van Assen and Snijders 2004). In addition, it has been suggested that subjects with S-shaped utility exhibit loss aversion, that is, subjects dislike a loss more than they like a comparable gain (e.g., Kahneman and Tversky 1979, 1984, Tversky and Kahneman 1991, 1992). Loss aversion refers to the relative steepness of the utility function for losses in comparison to gains. [2]

In our statistical analysis below, we employ two parametric forms of utility functions, namely power-shaped utility functions and S-shaped utility functions. To avoid confusion in later analyzes we distinguish the curvature parameter α in α_p for power-shaped utility and α_s for S-shaped utility. The *power-shaped* utility function is

$$u(z) = (z+\mu)^{\alpha_p}, \text{ with } z \geq -\mu,\ \alpha_p > 0.$$

A person with $0 < \alpha_p < 1$ is (globally) risk averse, and a person with $\alpha_p > 1$ is (globally) risk seeking. Subjects with $\alpha_p = 1$ are said to be risk neutral.

The *S-shaped utility* function is commonly represented by

$$u(z) = \begin{cases} z^{\alpha_s} & \text{for } z \geq 0, \text{ and } 0 < \alpha_s < 1 \\ -\lambda(-z)^{\alpha_s} & \text{for } z < 0,\ \lambda > 1, \text{ and } 0 < \alpha_s < 1. \end{cases}$$

For S-shaped utility we assumed that α_s is the same under gains and losses, as described by Kahneman and Tversky (1992). Subjects are loss averse if $\lambda > 1$. For example, if $\lambda = 1.3$, it means that a loss is 1.3 times as 'bad' than a comparable gain.

4.2.4 Analysis

In Chapter 2, we presented a game-theoretic analysis of the ISG. We restrict our attention to trigger strategies. Trigger strategies are a particular implementation of reciprocity. A trigger strategy is never the first to refuse support, but if the other actor refuses support even once, a

[2] We exclusively focus on those assumptions of Prospect Theory that are consistent with Expected Utility Theory (see, e.g., Kahneman and Tversky 1979). Therefore, we assume that probability weighting has no influence on loss attitudes. See for further discussion Raub and Snijders (1997: pp. 274 and 279). Also, we neglect that framing may shift the 'reference point' that seperates the gains and losses.

trigger strategy refuses support from that time onwards. Even after an own ‘unintended’ refusal of support, trigger strategies refuse support from then on. A trigger strategy is a *totally unforgiving* strategy that employs *permanent retaliation*. We do not claim that people in fact use trigger strategies. The analytical treatment of trigger strategies, however, is relatively easy. Moreover, they do serve an important *theoretical* purpose for the study of the preconditions of cooperation. Namely, if exchange of social support is not individually rational among trigger strategies, then exchange of social support is not individually rational among other strategies either (Abreu 1988). If two actors use trigger strategies, they will both always provide support. Trigger strategies are in a subgame-perfect Nash equilibrium, if the following threshold condition is fulfilled (see Lemma 2.1),

$$w \geq \max(\zeta_A, \zeta_B) = \zeta^*, \tag{4.1}$$

with $\zeta_i = \dfrac{1}{\pi_i \eta_i + (1-\pi_j)}$, and assuming $\pi_A + \pi_B = 1$, with $\zeta_i = \dfrac{1}{\pi_i (1+\eta_i)}$.

Thus, social support depends on the dyadic continuation probability w, the neediness π_i, the utility functions $u_i(z)$, and the benefit-cost ratio $\eta_i = \frac{b_i}{c_i}$. Note that η_i depends on the outcomes of the support game and on the utility functions. The parameters b_i and c_i are utility *differences*, not utilities. The benefits b_i are the differences between i’s utilities, if i needs and receives support, and i’s utilities, if i needs but does not receive support. The costs c_i are the difference between i’s utilities, if i does not need support and does not give support, and i’s utilities, if i does not need but gives support.

It is individually rational to provide support if the continuation probability w exceeds the *dyadic* threshold ζ^*. If ζ^* decreases or w increases, the equilibrium condition ‘is more easily met’. We will interpret this to mean that ‘support is more likely’ if ζ^* decreases. Keeping w fixed, ζ^* will then be treated as an indicator for ‘how likely the exchange of support’ is among the actors. The *dyadic* threshold ζ^* depends on the *individual* thresholds ζ_i. The individual threshold ζ_i increases in the benefit-cost ratios η_i (i.e., increases in the costs and decreases in the benefits), and in the likelihood of needing support π_i.

4.2.5 Individual Properties and Interdependent Social Support

Our game-theoretic predictions are based on a common knowledge assumption. Thus, we implicitly assume that subjects’ own utility and the utility of the support partner can be considered as common knowledge. However, it is problematic to assume common knowledge on risk preferences. As risk preferences are ‘internal’ and are not obvious to the other actor, subjects can only form expectations about each others’ risk preferences and adjust such expectations by experiences (‘learning’). For simplicity we restrict our analysis to the effects of prior expectations on behavior and do not study the dynamics of expectations and behavior. To study the effects of dynamics of behavior we need a much more complicated model such as the Bayesian equilibrium of the ISG with incomplete information (Harsanyi 1967-68). We then have to answer questions such as whether it affects a risk averse person differently if he or she plays against a risk seeking or a risk averse person. However, this is a question for another study. In this study we analyze whether properties of risk preferences have an effect on social support *per se*, without effects of learning. We *assume* that actors' expect their support partner's risk preferences to be the same as their own risk preferences (*false consensus assumption*, see Snijders 1996: 60, Ross et al. 1977).

4.3 Hypotheses

4.3.1 Benefit-Cost Ratios

We derive predictions based on the dyadic threshold ζ^*. We use this threshold to predict the frequency of support for the different structural conditions, as well as for different risk preferences. The risk preferences of subjects have an effect on η_i and consequently on ζ^*. For opportunity situations, η_i can be written as

$$\eta_i(u_i, opport) = \frac{u_i(x_i + \overline{b}_i) - u_i(x_i)}{u_i(y_i) - u_i(y_i - \overline{c}_i)},$$

and for threat situations as

$$\eta_i(u_i, threat) = \frac{u_i(x_i) - u_i(x_i - \overline{b}_i)}{u_i(y_i) - u_i(y_i - \overline{c}_i)}.$$

We now analyze how the utility ratios $\eta_i(u_i, opport)$ and $\eta_i(u_i, threat)$ depend on risk preferences. For risk neutral preferences we get the same utility ratio for opportunity *and* threat situations, namely

$$\eta_i(linear, opport) = \eta_i(linear, threat) = \frac{\overline{b}_i}{\overline{c}_i}.$$

Globally risk seeking and global risk averse preferences are represented by a power utility function and so in opportunity situations, and assuming $x_i = y_i = 0$, we have

$$\eta_i(power, opport) = \frac{(x_i + b_i + \mu_i)^{\alpha_p} - (x_i + \mu_i)^{\alpha_p}}{(y_i + \mu_i)^{\alpha_p} - (y_i - c_i + \mu_i)^{\alpha_p}} = \frac{(b_i + \mu_i)^{\alpha_p} - \mu_i^{\alpha_p}}{\mu_i^{\alpha_p} - (\mu_i - c_i)^{\alpha_p}} = \frac{(\frac{\overline{b}_i}{\mu_i} + 1)^{\alpha_p} - 1}{1 - (1 - \frac{\overline{c}_i}{\mu_i})^{\alpha_p}}.$$

Similarly, for threat situations, we have

$$\eta_i\ (power, threat) = \frac{1 - (1 - \frac{\overline{b}_i}{\mu_i})^{\alpha_p}}{1 - (1 - \frac{\overline{c}_i}{\mu_i})^{\alpha_p}}.$$

With S-shaped utility functions the utility ratios for opportunity and threat are

$$\eta_i(s - shaped, opport) = \frac{1}{\lambda_i}\left(\frac{\overline{b}_i}{\overline{c}_i}\right)^{\alpha_s},$$

$$\eta_i(s-shaped, threat) \;=\; \left(\frac{\bar{b}_i}{\bar{c}_i}\right)^{\alpha_s}.$$

4.3.2 Opportunities and Threats

Taking into account that the smaller η_i, the larger ζ^* we can analyze whether support is more likely in opportunity or threat situations by comparing the respective η's. To explicate that the dyadic threshold ζ^* depends on risk preferences and on the opportunity versus threat distinction, we write $\zeta^*(u_i, opport)$ and $\zeta^*(u_i, threat)$.

First, we study the effect of the *size* of the curvature parameter α on social support. We only focus on the power-shaped utility function and do not report the S-shape utility function for reasons that are discussed in Section 4.5.1. Independent of whether subjects are globally risk averse or globally risk seeking, it is easily seen that $\eta_i(power, opport)$ increased in α_p and $\eta_i(power, threat)$ decreases in α_p. Thus, the less risk averse or the more risk seeking the subjects are (i.e., the larger α_p), the less support we expect in threat situations and the more support we expect in opportunity situations.

Hypothesis 4.1 (opportunity versus threat: curvature effects): *The less globally risk averse or the more globally risk seeking an actor, the smaller the actor's probability of providing support in threat situations and the larger the actor's probability of providing support in opportunity situations.*

We now address the effects of specific risk preference types on behavior in threat and opportunity situations. First, under risk neutrality (α_p = 1), η_i is the same for opportunity and threat situations ($\eta_i(linear, opport) = \eta_i\,(linear, threat)$). Consequently, the dyadic threshold in opportunity situations equals the dyadic threshold in threat situations: $\zeta^*(linear, opport) = \zeta^*(linear, threat)$. We therefore do not expect differences in behavior in opportunity and threat situations for risk neutral subjects.

Second, we consider the power utility functions. For global risk aversion (α_p < 1), η_i is smaller in opportunity situations than in threat situations $\eta_i(power, opport)$ $< \eta_i\,(power, threat)$. Thus, the dyadic threshold is larger in opportunity than in threat situations $(\zeta^*(power, opport) > \zeta^*(power, threat))$. For globally risk seeking utilities (α_p >1), $\eta_i(power, opport) > \eta_i\,(power, threat)$ and $\zeta^*(power, opport) < \zeta^*(power, threat)$. These assertions can be proved by Jensen's inequality of convex analysis (e.g., Ash 1972). Therefore, we expect the probability of providing support to be larger in threat than in opportunity situations for risk averse subjects, and we expect it to be smaller in threat than in opportunity situations for risk seeking subjects.

Third, we consider S-shaped utility. For S-shaped utility *without* loss aversion (λ=1, and so $u(z)=-u(-z)$), η_i is the same in opportunity and in threat situations $\eta_i(s-shaped, opport) = \eta_i(s-shaped, threat)$, and, consequently, $\zeta^*(s-shaped, opport) = \zeta^*(s-shaped, threat)$. For S-shaped utility *with* loss aversion (λ > 1) we observe that the loss aversion parameter affects $\eta_i(s-shaped, opport)$ but does not affect $\eta_i(s-shaped, threat)$. Thus, $\eta_i(s-shaped, opport) < \eta_i(s-shaped, threat)$. Consequently, $\zeta^*(s-shaped, opport) > \zeta^*(s-shaped, threat)$.The difference between opportunity and threat increases with the extent of loss aversion. Consequently, we predict the probability of providing support to be equal under threats and opportunities for subjects with S-shaped utility without loss aversion; and we predict the probability of providing support to be larger in threat situations than in opportunity situations for loss aversion. Based on these assertions, we formulate three hypotheses:

Hypothesis 4.2.1 (opportunity versus threat: globally risk averse and S-shaped utility with loss aversion): *If actors are (globally) risk averse or have S-shaped utility with loss aversion, their probability of providing support is larger in threat than in opportunity situations.*

Hypothesis 4.2.2 (opportunity versus threat: globally risk seeking): *If actors are (globally) risk seeking, their probability of providing support is smaller in threat than in opportunity situations.*

Hypothesis 4.2.3 (opportunity versus threat: risk neutral and S-shaped utility without loss aversion): *If actors are risk neutral or have S-shaped utility without loss aversion, their probability of providing support is the same in threat and in opportunity situations.*

What are the intuitions behind these predictions? Risk averse subjects try to avoid risks. These subjects are strongly motivated by the worst outcome of the opportunity and threat situations to provide support, i.e., to be threatened by a loss and not to receive support. The situation is opposite for globally risk seeking subjects. These subjects do not hesitate to take a risk. Consequently, they are strongly motivated by the best outcome of the opportunity and threat situations to provide support, i.e., to have an opportunity of an additional gain and to realize it. Thus, in line with our hypotheses, we expect risk averse subjects to be more supportive in threat than in opportunity situations, and risk seeking subjects to be more supportive in opportunity than in threat situations. Following our intuitive reasoning, we expect subjects with S-shaped utility without loss aversion to be equally strongly motivated by the worst and the best outcome in opportunity and threat situations. Consequently, we do not expect a difference in their behavior. However, if these subjects are loss averse, i.e., if they are 'more focused on loss than on gain', they are more strongly motivated by the worst outcome, which is being under threat while not receiving support. Thus, they have a stronger interest in mutual support in threat than in opportunity situations.

We furthermore hypothesized that the larger α_p, i.e., the less risk averse or the more risk seeking a subject is, the more support we expect in opportunity situations. This hypothesis is in line with the reasoning that risk seeking subjects are strongly motivated to provide support in opportunity situations, and risk averse subjects to provide support in threat situations. In the literature on cooperation and support it has been repeatedly argued that "losses are a more powerful motivator than gains" (Walder 1994: 4). This argumentation has been supported by historically important social movements (see for a further discussion Hardin 1982). We emphasize that our hypotheses imply that, without information about the distribution of risk preferences in a population, we *cannot* predict whether there is more support in threat or in opportunity situations. Thus, we cannot answer the question whether support is easier in opportunity or in threat situations without taking into account the distributions of subjects' differences in risk preferences (see also Raub and Snijders 1997).

4.3.3 Heterogeneity

We now address the consequences of heterogeneity and homogeneity in the neediness of social support. Assuming that $\pi_A + \pi_B = 1$, it is easy to see that the larger the difference $\pi_A - \pi_B$, the larger the difference between the individual thresholds ($\zeta_A < \zeta_B$), and the larger $\zeta^* = \max(\zeta_A, \zeta_B)$ will be (for a general proof that heterogeneity in one parameter hampers support, see Appendix A, for empirical evidence Chapter 3). Thus, irrespective of whether a subject is risk averse or risk seeking, we hypothesize that social support is less likely if subjects differ in neediness than if subjects are fully homogeneous (this is based on the assumption that both actors have the same risk preferences; referring to false consensus, which is what we actually assume throughout this chapter).

Hypothesis 4.3 (heterogeneity in neediness): *Independent of risk preferences, the threshold condition is more restrictive under heterogeneous than homogeneous distributions of* π. *Thus, we predict the probability of social support to be larger if* $\pi_A = \pi_B$ *than if* $\pi_A \neq \pi_B$.

Finally, we address the interaction between the risk preferences and the structural conditions, namely heterogeneity in neediness and opportunity versus threat. We showed that heterogeneity in π has a negative effect on the probability of providing support, i.e., the more heterogeneous π_i the larger ζ^*. The size of η_i depends on the underlying utility function; the larger α_p the smaller $\eta_i\,(power, threat)$ and the larger $\zeta^*(power, threat)$. Also, the larger

α_p, the larger $\eta_i(power, opport)$ and, consequently, the smaller $\zeta^*(power, opport)$. Thus, ζ^* depends on η_i and α_p. To study the interaction of π_i and α_p, we turned to simulation. We simulated the derivative of $\eta_i(power, opp)$ and $\eta_i(power, thr)$ in α_p and π. The simulation is based on the following parameters: $b_i \sim U[0,1]$, $c_i \sim U[0,b]$, $\alpha_p \sim U[0,3]$, $\pi = U[0, 0.5]$, and $\mu = 100$, where $U[l, h]$ stands for the uniform distribution on $[l, h]$. The simulation shows that $\frac{\partial^2 \eta_i}{\partial \pi_i \partial \alpha_p} > 0$ in more than 99% of the simulation in opportunities as well as in threat situations. We could not come up with a clear interpretation of the rare conditions under which the second order derivative is negative. Thus, we predict that the interaction of α_p and π_i has a negative effect on ζ^* and therefore on social support in both threat and opportunity situations.

Hypothesis 4.4 (heterogeneity in neediness and the curvature parameters): *The interaction of heterogeneity in π and the curvature parameter α_p has a negative effect on the probability of social support being provided in threat and opportunity situations.*

4.4 Experiment

To test the hypotheses, an experiment was carried out at the Experimental Laboratory for Sociology and Economics (ELSE) at Utrecht University, the Netherlands, in October 2005.[3]

Subjects: Subjects were recruited through a database for subjects willing to participate in experiments (ORSEE, Greiner 2004). In total 100 subjects participated in the experiment. Most subjects were undergraduates from Utrecht University, coming from a variety of disciplines. The age of the subjects was on average 21 years old (std. dev. 5.1), and 62% were female.

Procedure: The experiment was conducted using the z-Tree software (Fischbacher 1999). The subjects could not see each other or each other's computer screens during the experiment. Subjects were explicitly asked to be quiet during the experiment. The experimenter and an assistant were always present in the laboratory to answer questions. The experiment consisted of three parts. In the first part, utility preferences of subjects were assessed. In the second part, subjects played a number of ISGs. The third part comprised a questionnaire about background variables on social support. We now provide a more detailed description of the three parts.

Utility Assessment: Decision making under risk can be viewed as a choice between a gamble and a sure outcome. Individual behavior is risk averse when the individual prefers the

[3] ELSE was initiated by V. Buskens and S. Rosenkranz on a grant from Utrecht University. We gratefully appreciate the possibility to use the ELSE facilities.

expected value of a gamble over the gamble itself, and risk seeking when the subject prefers the gamble over its expected value (e.g., Kahneman and Tversky 1979, Tversky and Kahneman 1992, Dacey 2003). Thus, to measure the risk preferences, subjects were confronted with five choice situations $\langle(p, v, 1-p, w), z\rangle$ in which subjects made a decision between a sure outcome z and a gamble (p, v, $1–p$, w), yielding v with probability p and w with probability $1–p$. Most simple methods of risk preference assessment present subjects with two gambles with a sure outcome such as $\langle(p, v, 1-p, w), z\rangle$, whereby one gamble with $v, w, z \geq 0$, and the other gamble with $v, w, z \leq 0$ (e.g., Raub and Snijders 1997). We extended this method by adding to each gamble several, increasing sure outcomes z_i.[4] The extension of the method allows us to estimate the curvature parameter of the subjects more precisely. The subjects were told that the amounts involved in the gambles are in euros and that these are hypothetical situations which have nothing to do with the payment for partaking in the experiment. Former studies on individual decision behavior under risk using real monetary incentives did not lead to different results than studies with hypothetical payoffs, such as our study (e.g., Tversky and Kahneman 1992, Camerer 1995, 2003, Beattie and Loomes 1997).

The five different choice situations are listed in Table 4.1. For instance, in the first choice situation (CS_1) subjects were asked to choose between the gamble (½, 100, ½, 0), and the sure outcome z_i specified as 70, 60, 55, 50, 45, 40, and 30 euro. In words: Subjects were asked whether they prefer the gamble of *winning* 100 euro with a chance of 50% or winning nothing with the same chance over the sure outcome of 70 euros. Then the same question was asked for the sure outcomes 60, 55, 50, etc. This choice situation allows us to estimate utility functions for gains. The second choice situation (CS_2) comprised all losses, and allows us to measure utility functions for losses. The third choice situation (CS_3) was a mixed situation, i.e., subjects could win *and* lose euros. The fourth and fifth choice situations (CS_4) are also mixed situations. They were included to test the consistency of subjects' preference with the utility model. How we estimated subjects' curvature out of the five choice situations is described in Section 4.5.1. The order in which the gambles were presented to the subjects was varied systematically, but did not affect behavior.

Table 4.1 Choice situations of risk assessment.

Choice situation	Gamble	Sure outcomes	Comment
CS_1	(½, 100, ½, 0)	(70, 60, 55, 50, 45, 30)	Outcomes are gains
CS_2	(½, 0, ½, -100)	(-70, -60, -55, -50, -45, -30)	Outcomes are losses
CS_3	(½, 40, ½, -40)	(20, 15, 10, 5, 0, -5, -10, -15,-20)	Outcomes are mixed
CS_4	(½, 60, ½, -20)	(40, 30, 20, 10, 0, -10)	Outcomes are mixed
CS_5	(½, 20, ½, -60)	(-40, -30, -20, -10, 0, 10)	Outcomes are mixed

[4] See the English translation of the risk assessment used in the experiment in Appendix C for more information on the utility assessment.

In this risk assessment method, we do not vary the probabilities between the gambles; we only vary the sure outcomes. Empirical studies on individual decision making have shown that subjects tend to overweight small probabilities and underweight intermediate to large probabilities (Kahneman and Tversky 1979, 1992, Wu and Gonzalez 1996, 1999). By fixing the probability at 0.5 and only varying the sure outcomes, we hope to diminish the problem of over or underweighting probabilities (for a similar risk assessment method, see Kahneman and Tversky 1992).

Conditions: The experiment has a two-by-two design, crossing opportunity and threat situations, with the homogeneity and heterogeneity of neediness. The opportunity and threat manipulation follows the description in Section 4.2.2. We compare homogeneity in neediness $\pi_A = \pi_B = 0.5$ with heterogeneity in neediness $\pi_A = 0.3$, $\pi_B = 0.7$. We use $\overline{b_i} = 24$ and $\overline{c_i} = 8$ throughout. A comparison of the four conditions in Table 4.2 suffices to test our hypotheses. The rows describe the four different conditions of the experiment, the parameters, and the predictions based on the dyadic threshold. We report the dyadic threshold ζ^* under risk neutrality, globally risk seeking utility, globally risk averse utility, and S-shaped utility for specific parameter values. The larger ζ^*, the more restrictive the threshold condition, and subsequently the smaller the probability of social support.

The predictions for S-shaped utility are based on $\alpha_s = 0.89$ and $\lambda = 2$. These values are taken from empirical evidence reported in Kahneman and Tversky (1992) as well as Gonzalez and Wu (1999). The predictions for globally risk averse utility are based on $\alpha_p = 0.89$ and for risk seeking utility on $\alpha_p = 1.12$ ($=\frac{1}{0.89}$), with $\mu_i = 24$. The entries in Table 4.2 are of course consistent with our hypotheses. For risk neutral actors, the threshold condition is more restrictive under heterogeneity than under homogeneity (0.55<0.83), and indeed does not differentiate for opportunity and threat. For risk seeking actors, the threshold condition is more restrictive in the threat situation than in the opportunity situation (0.47<0.54 and 060<0.66). For risk averse subjects the situation is reversed and the threshold is less restrictive in the threat than in the opportunity situation (0.46<0.52 and 0.59<0.65). For subjects with S-shaped utility, the threshold condition is less restrictive under the threat situation than under the opportunity situation, and heterogeneity strengthens the negative effect of loss aversion (0.86<0.91 and 0.55<0.67).

Table 4.2 Experimental conditions.

Condition	Parameters			Trigger thresholds			
	$\frac{b_A}{c_A} = \frac{b_B}{c_B}$	π_A	π_B	Risk neutrality	Risk seeking	Risk aversion	S-shaped
C_1: Homogenous Opportunity	$\frac{24}{8}$	0.5	0.5	0.50	0.47	0.52	0.86
C_2: Heterogeneous Opportunity	$\frac{24}{8}$	0.7	0.3	0.83	0.60	0.65	0.91
C_3: Homogeneous Threat	$\frac{24}{8}$	0.5	0.5	0.50	0.54	0.46	0.55
C_4: Heterogeneous Threat	$\frac{24}{8}$	0.7	0.3	0.83	0.66	0.59	0.67

Iterated Support Game: The subjects played two-persons *Finitely repeated Support Games* (FSGs). In the beginning of each FSG, subjects were randomly matched with other subjects. In order to play heterogeneous FSGs, subjects received different roles (A and B) at random. In a heterogeneous situation role A and B differed in neediness as shown in Table 4.2. Each FSG took 5 rounds, i.e., 5 decision situations; see discussion on finitely repeated versus infinitely repeated games below. Each subject played FSGs under two different conditions. Under each condition, subjects played 6 FSGs, half of the subjects in role A and half of them in role B. Subjects knew the parameters of the game (b_i, c_i, π_i), the number of FSGs to be played, and the number of rounds per FSG. The experiment contained eight sessions with the following conditions: (C_4, C_1), (C_3, C_2), (C_4, C_2), (C_3, C_1), (C_2, C_3), (C_1, C_4), (C_2, C_4), (C_1, C_3).

To make the support situations more realistic (in terms of incentive comparability), the subjects' behavior in the FSGs determined how much they would earn in the experiment. After completing the first part of the experiment, subjects received an endowment of 1000 points, which is equivalent to 10 euros.[5] In an opportunity situation, all subjects had the chance to receive some extra points with a given probability ('likelihood of needing support'). At one decision situation, the subject in either role A or role B had the opportunity to gain additional points ($b_i = 24$). The other half of the subjects could seize this opportunity for their game partner by returning some of their own endowment ($c_i = 8$). A subject received the additional gain if his or her partner gave away some of his or her own endowment ('actor B provides and actor A receives support'). Consequently, a subject did not receive the additional gain if the partner did not give away a part of his or her own endowment ('actor B does not provide and actor A does not receive support').

In a threat situation, subjects were threatened to lose points with a certain probability ('likelihood of needing a support'). In one decision situation, either A or B were threatened to lose points ($b_i = 24$). The other half of the subjects could overcome this threat to their game partner by giving away some of their own endowment ($c_i = 8$). A subject overcame the threat and did not lose any endowment if his or her partner gave away some of his or her own endowment ('actor B provides and actor A receives support'). Consequently, a subject lost

[5] See for a discussion on 'gambling with the house money' Thaler and Johnson (1990) or Raub and Snijders (1997: 286).

points if his or her partner did not give away some of his or her own endowment ('actor B does not provide and actor A does not receive support').

As described above, we employ a *finitely* repeated game (FSG) although our theory and consequently our predictions are based on an *indefinitely* repeated Support Game (ISG). We are aware that standard game theory predicts that Ego would not provide support in the last round of a finite game; Alter, anticipating Ego's behavior, will therefore not provide support either in the round before, etc. This argument, known as 'backward induction' (e.g., Selten 1978), unravels the whole FSG back until the first stage, making any support impossible. Numerous laboratory experiments with finitely repeated games, however, have shown that subjects do cooperate in finitely repeated games and that usually only in the very last rounds cooperation rates decrease dramatically (e.g., Selten and Stoecker 1986, Camerer and Weigelt 1988). This holds true for our experiment as well. In the first round, 84% of the subjects provided support, but in the fifth and last round of a FSG only 19% of the subjects provide support. A rough comparison of our support rate with an experiment under similar conditions, but based on an ISG (Chapter 3) with an *expected* duration of 5 rounds, shows support rates of 86% in the first round under homogeneity, and of 75% under heterogeneity. Since our hypotheses concern the first round of an interaction, and given the high percentage of support in the first round, we do not expect an effect of the backward induction on behavior in the first round. Furthermore, we feared that due to the complexity of the heterogeneous and homogeneous opportunity and threat setting, another unknown quantity (the number of rounds) would make the situation too difficult for the subjects, and consequently we decided to employ FSGs despite the fact that our predictions are based on ISGs.

Questionnaire: After playing the games, subjects filled in a questionnaire on some basic demographics and they were asked to evaluate a number of statements on denying and giving help. Furthermore, before playing the games we measured the social orientation of the subjects (see van Lange et al. 1992, 1997, 1999) and subjects' discount parameter. These additional scales are not used in this chapter. In total, an experimental session took about one hour.

Rewards for participation: At the end of the experiment all the points that subjects gained or lost by playing the FSGs were transferred in euros (100 points = 1 euro). Additionally subjects received 2 ½ euros for participation. Subjects received 14 euros on average.

4.5 Results

4.5.1 Risk Preferences

In this subsection we report on the risk preference measurement. To assess the risk preferences we estimate the parameters α_p of power-law utility functions, as well as the parameters α_s and λ of S-shaped utility for each subject. First, we checked the answers of the subjects for Guttman type consistency. If a subject prefers the gamble to a sure outcome *r*, the subject should prefer the gamble to each smaller sure outcome *s*. We want to emphasize that this form of consistency does not really require 'standard' expected utility theory. Non-standard theories with non-linear probability weighting predict the same. We found few inconsistent choices, except for choice situation CS_3. There, 39% of the subjects violated the Guttman scale property. We do not have an explanation as to why subjects had more problems with CS_3 (outcomes were mixed: (½, 40, ½, -40) with a certain outcome of (20, 15, 10, 5, 0, -5, -10, -15, -20)) than with any other choice situation. Consequently, we exclude CS_3 in our risk preference measurement.

Second, we estimate for each subject in each choice situation the indifference value, i.e., the point where a subject changes from preferring a sure outcome to a gamble towards preferring the gamble to the sure outcome. In most cases, the indifference value was estimated simply as the midpoint between the last sure outcome that is preferred above the expected value of the gamble and the next sure outcome that is not preferred above the expected value (for instance, 12.50 euros if a subject still preferred the sure outcome of 10 euros over the gamble but not the following sure outcome of 15 euros). For 'extreme' preferences, i.e., subjects who always prefer the gamble or always prefer the sure outcome we assumed that their preference would have changed with a value of 5 euros larger or smaller than the extreme values we provided, and that they would then use the associated midpoints (e.g., 72.50 euros if 70 euros was the extreme value).

Third, we estimate the parameters of the power-shaped and S-shaped utility functions using non-linear least squares, noting that the indifference between the expected value of the gamble and the sure outcome *x*, $x \sim (\frac{1}{2}, v, \frac{1}{2}, w)$ can also be written as $x = u^{-1}(\frac{1}{2}u(v) + \frac{1}{2}u(w))$, with the utility function *u*. Somewhat arbitrarily, we say that a utility function fits the choices of a subject if $R^2 \geq 0.80$.

Table 4.3 summarizes the power-utility parameters of the subjects whose choices are consistent with power-utility. We consider subjects to be globally risk averse if $\alpha_p < 0.90$, and to be globally risk seeking if $\alpha_p > 1.10$. Subjects are approximately risk neutral if $0.90 < \alpha_p < 1.10$. With these cut-points, 39% of the subjects are risk averse, 36% are risk neutral, and 14% are risk seeking. Being 'less strict' we consider subjects as risk neutral if $0.95 < \alpha_p < 1.05$. Then 48% of the subjects are risk averse, 19% risk neutral, and 22% risk seeking. In any case, we note that a reasonable number of subjects have risk preferences close to risk neutral utility.

Table 4.3 Subjects' power-utility parameters.

Parameter Distribution	Frequency based on power-shaped utility
$0.00 < \alpha_p < 0.80$	22
$0.80 < \alpha_p < 0.90$	17
$0.90 < \alpha_p < 0.95$	9
$0.95 < \alpha_p < 1.00$	12
$1.00 < \alpha_p < 1.05$	7
$1.05 < \alpha_p < 1.10$	8
$1.10 < \alpha_p$	14
Number of subjects	89

The results for S-shaped utility are reported in Table 4.4. We report the joint distribution of the risk parameter α_s and the loss aversion λ. We consider subjects with $\alpha_s < 0.95$ as having S-shaped utility. These subjects, in total 28%, are risk averse for gains and risk seeking for losses. 9% of these subjects are classified as having S-shaped utility *with* loss aversion, and 7% as having S-shaped utility *without* loss aversion. 12% have S-shaped utility with $\lambda < 0.95$. These subjects are the opposite of loss averse, i.e., they are 'loss seeking' and prefer a loss of x over a gain of x. If we consider subjects to be approximately risk neutral if $0.95 < \alpha_s < 1.05$ then 25% of all subjects are risk neutral. The largest percentage of subjects has a utility function *opposite* to S-shaped utility ($\alpha_s > 1.05$), namely 45%. These subjects are *risk seeking* for *gains* and *risk averse* for *losses*. We do not consider these subjects in our analysis, since $\alpha_s > 1.05$ contradicts with our assumption on S-shaped utility that $0 < \alpha_s < 1$. We have no other explanation for the large number of subjects with $\alpha_s > 1.05$ than concluding that most subjects do not have S-shaped utility.

Table 4.4 Number of subjects with specific values for loss aversion and S-shaped utility.

Loss aversion	S-shaped parameter $0 < \alpha_s < 0.95$ (S-shaped)	$0.95 < \alpha_s < 1.05$ (risk neutral)	$1.05 < \alpha_s < 3$ (non S-shaped)	Comment
$1.05 < \lambda$	9	12	10	loss averse
$0.95 < \lambda < 1.05$	7	4	15	loss neutral
$\lambda < 0.95$	12	9	20	loss seeking
Total	28	25	45	

Due to the following reasons we decided to base the further analysis only on power-shaped utility and neglect S-shape utility. First, we cannot distinguish whether a subjects' risk parameter is better explained by power-shaped utility or by S-shaped utility. The R^2 is relatively large for both utility functions, i.e., both utility functions fit the data roughly equally well. Second, concerning S-shaped utility, we lose a reasonable number of subjects who are approximately risk neutral (25%) or inconsistent with our assumptions (45%). Thus, our hypothesis that subjects with loss aversion are more supportive in threat than in opportunity situations could only be tested with 9 subjects. Similarly, the hypothesis that subjects with S-shaped utility without loss aversion do not differ in opportunity and threat situations could only be tested with 7 subjects. Such tests would have low statistical power. We rather focus exclusively on power-shaped utility to test our hypothesis than on the small percentages of subjects with S-shaped utility with or without loss aversion.

Considering the distributions of S-shaped and power-shaped utility, we want to stress that there is only limited variation in risk preferences. For power-shaped utility as well as for S-shaped utility, subjects' utility functions are often close to risk neutral. For power-shaped utility we find, besides risk neutral subjects, a reasonable percentage of subjects with risk averse utility. However, even for these subjects the curvature parameters are often close to the risk neutrality cut-point. The same holds true for S-shaped utility. Next to the 25% of subjects with risk neutral utility, quite a number of the subjects classified as having S-shaped utility actually have risk preferences close to the risk neutrality cut-point.

4.5.2 Distribution of Risk Preferences and Social Support

Our main interest in this study is how the degree of supportive behavior differs between structural conditions (threat versus opportunity, homogeneity versus heterogeneity), and between subjects' risk preferences. Support is measured by the first decision in the FSG. Responses in later rounds are likely to be influenced by the responses of the partner in previous rounds. This requires another type of theory than the theory of repeated games with complete information (see Chapter 5). This section discusses the statistical tests of our hypotheses based on power-shaped utility. First we consider our hypotheses on the differences in behavior between opportunity and threat situations for different kinds of risk preference types. Second, we test our hypothesis on the interaction effect of the curvature parameter α_p and heterogeneity in neediness.

Table 4.5 reports the proportion of support in the four conditions for different risk preferences. For risk neutral subjects we do not expect a difference in behavior between opportunity and threat situations. Risk averse subjects are predicted to be more supportive in threat than in opportunity situations. In contrast, risk seeking subjects are expected to provide support more easily in opportunity than in threat situations. We find only partial support for the hypothesis on the behavior of risk neutral, risk averse, and risk seeking subjects. To obtain fundamental tests, we use a logistic regression with random subject effect (see, e.g., Fischer 1997: 226-227). None of the Wald tests for the differences between the conditions are significant, except for the difference between homogeneous threat situations and homogeneous opportunity situations under risk seeking. There we find a significant difference as predicted. We do not provide more detail on the Wald tests. We therefore consider two reasons for why almost none of our hypotheses are confirmed. First, the variance of the distribution of risk preferences was very small. Moreover, most of the subjects' risk parameters are close to one, i.e., close to risk neutrality. Then the differences among opportunity and threat are likely small anyway. The statistical power of our tests is thus very low. Second, the initial support rate of 84% in the first round is pretty high, and this again reduces statistical power. We did the same tests for different kinds of risk preference type classifications, always leading to the same nonsignificant results.

Table 4.5 Proportion of support by condition and by risk preference.

Condition	Risk neutrality $0.95 < \alpha_p < 1.05$		Risk aversion $\alpha_p < 0.95$		Risk seeking $\alpha_p > 1.05$	
	Support	Prediction	Support	Prediction	Support	Prediction
Homogeneous Threat	0.97	Threat =	0.89	Threat >	0.66	Threat <
Homogeneous Opportunity	0.95	Opportunity	0.87	Opportunity	0.91	Opportunity
Heterogeneous Threat	0.80	Threat =	0.79	Threat >	0.72	Threat <
Heterogeneous Opportunity	0.80	Opportunity	0.90	Opportunity	0.71	Opportunity
Number of subjects	19		48		22	

A somewhat more powerful test of our hypotheses employs a 'continuous' risk parameter α_p, testing whether an increase in α_p leads to more support in opportunity situations and less support in threat situations (see Hypothesis 4.1). Furthermore, we test whether there is a negative interaction effect between the curvature parameter α_p (individual property) and the structural conditions (homogeneous versus heterogeneous threat and homogeneous and heterogeneous opportunity), as predicted in Hypothesis 4.4.

We use again a logistic regression with a random subject effect. Table 4.6 reports the main model. None of the effects are significant. OPPORTUNITY has a positive and nonsignificant effect on the probability of support being provided in the first round. We, furthermore, find a positive and nonsignificant interaction effect of OPPORTUNITY and α_p. In contrast to earlier experiments on the ISG, we do not find a negative effect of HETEROGENEITY on the probability of providing support, nor is the negative interaction effect of HETEROGENEITY and α_p significant. However, if we include *only* HETEROGENEITY and do not restrict the analysis to the first round, we find a significant negative effect on the probability of support being provided in the first round (-0.181, with one sided $p = 0.01$) that disappears by adding the curvature parameter α_p and the interaction effect of the two variables, as well as by adding the OPPORTUNITY variable and the interaction effect with α_p.

Table 4.6 LLTM with random subject parameters.

Support in the first round	coef	se
Heterogeneity (ref: homogeneity)	0.452	1.001
Opportunity (ref: threat)	- 0.112	0.760
Risk parameter α_p	0.037	1.161
Interaction α_p and heterogeneity	- 0.748	1.081
Interaction α_p and opportunity	0.570	0.810
SD of subject	1.482	0.243
Loglikelihood	-172.352	
Number of decisions	527	
Number of subjects	87	

4.6 Conclusion and Discussion

In this study, we compared social support in threat and in opportunity situations. Furthermore, we studied how individual differences with respect to risk preferences affect decisions in these structural conditions. Our theoretical analyzes yielded new hypotheses on the ISG. We hypothesize that risk averse subjects are most supportive under threats, and risk seeking subjects' are most likely to provide support under opportunities. Therefore, whether there is more support in opportunity or threat situations depends on the distribution of risk preferences in a population. Subjects with S-shaped utility without loss aversion are not affected differently by opportunity and threat situations, whereas subjects with S-shaped utility with loss aversion are expected to provide more support in threat than in opportunity situations. Furthermore, we expect subjects to be less supportive under heterogeneity in neediness than under homogeneity in neediness. We also expected this affect to be more profound the more risk seeking and the less risk averse a subject is. These hypotheses have been tested by an experimental test. First, we measured subjects' risk preferences, and then let them play several FSGs under threats and opportunities. We do not find evidence that risk preferences affect support in opportunity and threat situations as predicted. Second, the hypothesis on heterogeneity is only partially confirmed, whereas the hypothesis on the interaction of heterogeneity and the risk preferences do not find any support. In the following, we first critically discuss the results concerning the assessment of risk preferences. Second, we discuss the findings concerning the FSGs, and third, we discuss the association between the risk preferences and the behavior in the FSGs.

We found only little variation in the risk preferences of the subjects. Moreover, many subjects are close to risk neutral. Our main conclusion is that there is not sufficient variation in subjects' risk preferences. These small empirical variations in the risk preferences likely lead to minimally different behavior at best. However, before we conclude that our predictions based on risk preferences are of dubious empirical relevance, we need to critically discuss the risk assessment method that we have used in our experiment. First, we note that the risk assessment was based on hypothetical questions. We did not use monetary incentives. We do not believe that the lack of material incentives has an effect on our results. There is some evidence in the literature that using incentives in the risk assessment can make subjects slightly more risk averse (Kachelmeier and Shehata 1992, Camerer and Hogarth 1999). However, as long as this small effect does not vary among subjects, the incentive effect cannot be expected to have a big impact on the *variation* of risk preferences. Thus, we do not expect different results by using monetary incentives instead of purely hypothetical situations.

Although it is often stated in the literature that risk assessment methods that take into account probability weighting (e.g., the Trade Off Method by Wakker and Deneffe 1996) lead to different results than those that do not, we do not expect significant changes in our results by using such a method. The Trade Off Method usually estimates more subjects having S-shaped utility than methods that do not take probability weighting into account (e.g., Fennema and Van Assen 1999). However, since our risk assessment method only uses gambles based on 50% chances, we do not think that probability weighting had an effect on the results of our risk preference measurement. By keeping the probabilities of the gambles fixed at 50% and only varying the sure outcomes, we diminished the effects of probability weighting in our measurement.

Another reason for the lack of variation in the risk preferences could be that the values of the risk assessment have not been extreme enough. However, the indifference point of most subjects has been in the proposed range. Only very few subjects did not change from preferring the gamble to preferring the sure outcome, or the other way around. Thus, for almost all subjects the range of the sure outcomes (20 to 70 euros, note that the experiment was done with a student population) was sufficient. We conclude that the ranges were extreme enough. The literature reports that more extreme values lead to even more risk averse utility (Krzysztofowicz and Duckstein 1980).

We are somewhat reluctant with respect to the advantage of a replication of the experiment, since adding observations would not have an effect on the lack of variation in the risk preference distribution. If the real differences are indeed small, there is little point in spending a lot of resources to study whether the small expected differences indeed exist. Given our empirical evidence, we do not presuppose that there is empirically sufficient variation in subjects' risk preferences. This leads to the conclusion that we neither confirm nor reject our hypotheses on the effects of risk preferences on support in opportunity and threat situations. We rather expect that these hypotheses are not empirically relevant. The variations in a populations' risk preferences are too small and consequently do not lead to substantially important differences in behavior.

We now focus on the part of the experiment where subjects played FSGs. We found limited variation in supportive behavior in the first rounds of the FSGs. The FSGs were played in such a way that subjects are very supportive in the beginning of each new FSG (84% provided support), whereas subjects hardly provided support at the end of an FSG (19%

of support in the last round). Therefore, it is difficult to obtain enough statistical power, certainty in combination with limited variation in risk preferences.

Finally, deriving theoretical predictions about the relation between risk preferences and supportive behavior is not unproblematic due to systematic deviation from the 'false consensus assumption'. We assume that actors expect the other actors' risk preference to be the same as their own. However, this assumption may be wrong. People may really be uncertain, and the amount of uncertainty may well vary with the own risk preferences.

To conclude, we discuss the effects of heterogeneity in neediness on social support. We did not find a significant effect of heterogeneity in neediness on support if we add other structural conditions, as well as the risk preferences. We only find a small significant effect of heterogeneity on social support if we include only heterogeneity in our model and do not restrict our analysis to the first rounds of the FSGs. In earlier studies, we have found highly significant negative effects of heterogeneity in neediness on social support, although in these instances we only studied the first rounds of an interaction (see Chapter 3). A reason for the different findings might be that the percentage of support is much higher in the first round in this experiment under homogeneity and heterogeneity than in the former experiment. Consequently, the lack of an effect of heterogeneity in the first round might be due to a lack of statistical power.

Chapter 5

Behavioral Dynamics of Social Support[*]

Abstract

This chapter studies the behavioral dynamics of social support between heterogeneous actors by discussing which actor provides support more often in a durable relation. We assume that each actor tends to provide support according to a specific ‘support ratio’ that he or she aims at. Such a support ratio depends on actors’ costs of providing support, benefits from receiving support, and likelihood of needing support. These support ratios define how often each actor provides support. Actors behave in order to implement their support ratios. We propose a new behavioral dynamics, in which actors seek to match their behavior with the support ratio. We derive the predictions of the support ratios from equity theory and bargaining theory. Data from two laboratory experiments have been used to test the predictions. Both theories are able to predict which actor will provide support more often in the experiment. With respect to the behavioral dynamics, the support ratios related to bargaining theory seem to predict the observed data slightly better than equity theory.

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5.1 Introduction

Two people in a durable support relation likely differ with regard to costs of providing support, benefits from receiving support, and the likelihood of needing support due to differences in, for instance, resources (see, e.g., Emerson 1962, 1972, Blau 1964, 1968). In this chapter we distinguish heterogeneity *between* actors in a support relation with respect to the *costs* of providing support and the *likelihood of needing* support. The following situation provides a good example of support between heterogeneous actors. Ms. Neumann and Ms. Morgenstern both work part time and they help each other from time to time by taking care of each others' children while the other is at work. Both women work as stand-by nurses in a hospital. Ms. Neumann has a two year old child, whereas Ms. Morgenstern has a daughter of twelve. It is more costly for Ms. Morgenstern to baby-sit Ms. Neumann's child than the other way around. A child of two usually needs more attention than a twelve year old. As a consequence, Ms. Morgenstern cannot do much housework while baby-sitting the two year old child. What is more, Ms. Neumann works in a department that is somewhat understaffed and the hospital calls her in more often than they do Ms. Morgenstern. It is intuitive to expect that Ms. Neumann is willing to help Ms. Morgenstern every time she asks for help, since the costs are relatively low for her and Ms. Morgenstern does not ask too often. Ms. Morgenstern, on the other hand, might not help Ms. Neumann every time she needs help and Ms. Neumann understands this perfectly, since she is relatively often in need of support and it is relatively costly for Ms. Morgenstern to provide support. Both women might strive for just such a 'deal' and in addition Ms. Neumann might hire a baby-sitter. Thus, both women are likely to have an 'idea' of how often each of them should provide support to the other such that both women are satisfied with their support relation. We can think of this 'idea' as a *support ratio* that defines how often Ms. Morgenstern shall support Ms. Neumann relative to how often Ms. Neumann shall support Ms. Morgenstern.

In former studies the dyadic, durable support relation has been modeled as an *Iterated Support Game* (see Chapters 2 and 3). In these former chapters 'ISG' referred to *indefinitely* iterated Support Games. In the present chapter 'ISG' refers to *iterated* Support Game, and we perform an experimental study of a 'finitely' and an 'indefinitely' *iterated* Support Game. In earlier game-theoretic analyses, actors are assumed to provide either full support or no support at all.

In this chapter we study the ISG using relatively simple and therefore less refined assumptions on behavioral dynamics rather than a standard game-theoretic analysis assuming strict rationality. We assume that each actor tends to provide support according to a *support ratio* that specifies how often each actor shall provide support given the other actor is in need. The question is, however, what specific support ratio an actor strives for. We call the support ratio that an actor strives for the *target* support ratio. We derive predictions about what constitutes a target support ratio from *equity* theory and from *bargaining* theory. The target support ratio can then furthermore be used to predict whether support will be provided or not based on actors' *common experiences* with each other as well as on a specific rule that *'matches' the experienced support ratio with the target support ratio*.

The 'extent' to which an actor provides support can be studied in terms of *fractional* support, e.g., Ego asks Alter for help for one day, but Alter helps for only half a day, or in terms of *probabilistic* choices, e.g., Alter refuses to help Ego half of the time that Ego requires help. Our theoretical and empirical analysis builds on the second definition. We refer to the support *ratio* as the proportion of times Alter provides support from all the times Ego needs support divided by the proportion of times Ego provides support from all the times Alter needs support.

The target support ratio depends on the actors' individual parameters such as the costs of providing support, the benefits from receiving support, and the likelihood of needing support. Heterogeneity will be introduced through the likelihood of needing support and the costs of providing support. As illustrated above, it is far from obvious that actors should provide support equally often if they differ, e.g., in their costs of providing support. Therefore, we will answer the question:

Which actor provides support more often?

Assuming that actors want to 'match' the experienced support ratio in a dyadic relation with the target support ratio, we can make predictions on actors' behavior: actors are more likely to provide support if providing support leads to a more even match of the experienced support ratio with the target support ratio than if providing support leads to a less even match with the target support ratio. Thus, if an actor's support ratio is 0.5, an actor is more likely to provide support if he or she has given support less than half as often as the partner has so far. This leads to the following question:

Do actors tend to 'match' the experienced support ratio with the target support ratio they strive for?

Note that whether or not both actors have the *same* target support ratio is irrelevant for the mechanism described above. Each actor tries to match the experience with the target support ratio that represents his or her target in such a way that he or she is more likely to provide support if providing support improves the match of the experienced and the target support ratios, otherwise he or she is less likely to provide support – independent of the behavior and the other actor's target support ratio. It is also important to note that we only focus on the support *ratio*. We do not study how often actors should provide support in *absolute* terms, we only study how often actors provide support, *relative* to each other.

In Section 5.2 we introduce the ISG. Theories and hypotheses will be presented in Section 5.3. We first introduce the behavioral assumptions of this study, and then define what constitutes a target support ratio based on equity theory and bargaining theory. Finally, we derive hypotheses from equity theory as well as bargaining theory. Section 5.4 describes the experimental tests. The results of the tests are presented in Section 5.5. The chapter concludes with a discussion in Section 5.6.

5.2 Social Support

We label the actors in the ISG as A and B. Figure 5.1 represents the stage game of the ISG as applied in the experiments (see Chapter 2 for details). For general assumptions on the parameters we use i to refer to any actor A or B, and j to refer explicitly to the other actor. We assume that exactly one actor is in need of support at each time point: Actor i needs support with likelihood π_i (from now on called *neediness*) with $\pi_A + \pi_B = 1$. If i receives support from j, i receives benefit b_i at costs c_j for j. We assume that $b_i > c_i > 0$, i.e., benefits from receiving support are larger than costs of providing support. Note that we make a within-actor comparison of the costs of providing support with the benefits from receiving support and do not compare the benefits of actor i from receiving support with the costs of providing support for actor j.

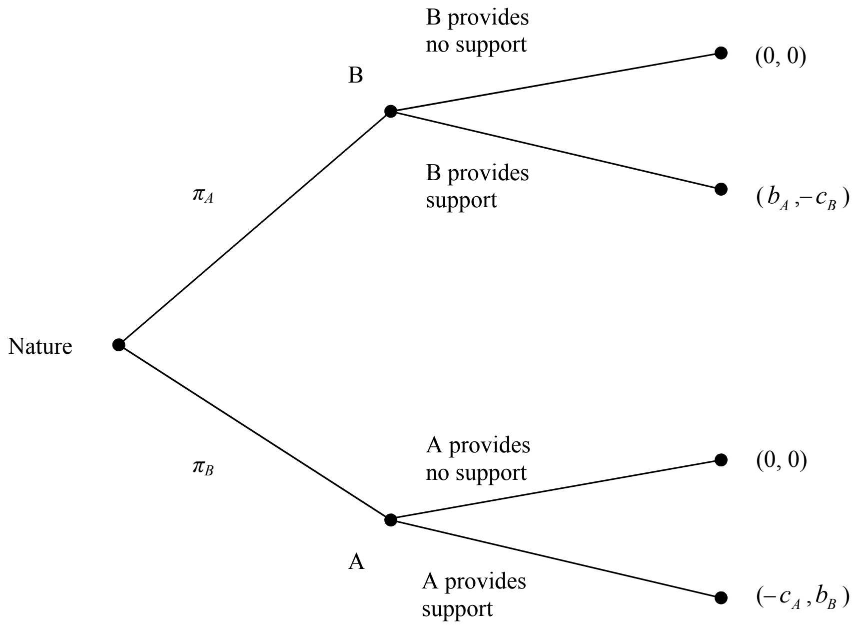

Figure 5.1 Extensive form of the Support Game (SG), with $b_i > c_i > 0$. The ISG is an iterated version of this game over time.

The ISG represents support decisions in a *durable* relation and is modeled as a repeated version of the game in Figure 5.1. Former studies have analyzed trigger strategy equilibria to derive the conditions under which it is individually rational to provide support (see Chapter 2 until 4). An actor using a trigger strategy never refuses to give support first, but after any refusal of support from the other actor, the actor refuses support from then on. By studying equilibria in these trigger strategies it is assumed that *both* actors either always provide support or never provide support on the equilibrium path. The analytical treatment of trigger strategies serves an important theoretical purpose. If exchange of social support is not individually rational between actors using trigger strategies, then it is not individually rational between actors using any other strategy (e.g., Abreu 1988).

Trigger strategies are *all-or-nothing* strategies: actors either provide full support, backed up by the threat to cancel all future support after any misdeed, or actors do not provide support at all. The restriction of these *symmetric* equilibria seems to some extent unreasonable. After all, we are interested in the effect of heterogeneity on support, but we assume all actors use the same strategies. The equilibrium condition itself, however, reflects these asymmetries. The all-or-nothing trigger strategy equilibrium is based on two individual thresholds; the individual thresholds depend on the individual parameters of the actors. Thus, heterogeneity among the actors leads to different individual thresholds. Since the all-or-nothing trigger strategy equilibrium depends on the maximum of the two individual thresholds (dyadic threshold), it reflects the heterogeneity between the actors, but nevertheless, in the equilibrium the actors are restricted to using the same strategies. However, it seems unreasonable theoretically that in a situation such that, for instance, actor A needs support twice as often as actor B, both actors provide full support. Instead, while actor A provides full support, actor B might provide support only every now and then. Also, experimental data (Chapters 3 and 4) indicate that heterogeneous actors indeed make different choices in a support relation, i.e., they do not necessarily provide support equally often.

We could now generalize trigger strategies to allow providing support with some probability, given support is needed. We could then derive hypotheses from comparative statics of the associated trigger equilibria (much like we did in Chapter 2). Still, trigger strategies are not suitable approximations for actual behavior, because the threat to stop all support after any deviation does not seem to be realistic and such a behavior is typically not observed in experiments either (Kagel and Roth 1995). We believe that trigger equilibrium analyses are appropriate for studying the first round of an ISG, but such analyses do not offer plausible predictions on actors' behavior after a deviation from the trigger strategy equilibrium path. We do not know of any other more realistic strategies for equilibrium analysis that are tractable for formal analysis. As an alternative research strategy we employ assumptions on adaptive behavior. Adaptive strategies often better resemble observed human behavior in experimental games (e.g., Camerer 2003: Chapter 1).

5.3 Theory and Hypotheses

5.3.1 Two Behavioral Assumptions

Our first behavioral assumption is that each actor provides support in accordance with a target support ratio that defines how often each actor provides support, given the other actor needs support. Thus, a target support ratio specifies how often A *and* B should provide support relative to each other. Knowing that it is more costly for Ms. Morgenstern to baby-sit Ms. Neumann's two year old child and knowing that Ms. Neumann needs support more often, it is likely that out of all times Ms. Neumann needs support Ms. Morgenstern will support Ms.

Neumann less often than Ms. Neumann will support Ms. Morgenstern out of all the times Ms. Morgenstern needs support. We define the *target support ratio* for A and B as the ratio of A's *conditional probability* α_A of providing support, given B needs support, and B's *conditional probability* α_B of providing support, given A needs support:

$$s_{AB} = \frac{\alpha_A}{\alpha_B} \ . \tag{5.1}$$

If $s_{AB} > 1$, this does not necessarily mean that actor A provides support more often than actor B – actor B may *need* support much less often than A, $\pi_B < \pi_A$. However, $s_{AB} > 1$ does imply that A provides support *relatively* more often than B does. Thus, α_A is A's *conditional* probability of providing support, given B needs support; whereas $\alpha_A \pi_B$ is A's *marginal* probability of providing support throughout the ISG. Therefore, which actor shall support more often throughout the ISG is determined by $\frac{\alpha_A \pi_B}{\alpha_B \pi_A} = s_{AB} \frac{\pi_B}{\pi_A}$. In this chapter, we describe and analyze social support by means of the *conditional* probability of providing support. Consequently, $s_{AB} > 1$ or $s_{AB} < 1$ specifies which actor has to provide support more often, *given the other actor needs support*. In the following, 'how often actor *i* provides support' refers to 'how often *i* provides support out of all times *j* needs support'. Principles that specify what target actors strive for will be discussed in the next section.

The second behavioral assumption is that actors seek to implement the support ratio in their common history. In our theoretical analysis we use an *experienced* support ratio reflecting actors' experienced behavior, and a *target* support ratio that reflects what actors strive for. We define actor A's *experienced* behavior as the 'real proportion of provided support' of A, i.e. p_A = (number of times A supported B)/(number of times A *could have* supported B), and p_B analogous. The *experienced support ratio* of actor A is simply

$$a_{AB} = \frac{p_A}{p_B} \ . \tag{5.2}$$

The behavioral dynamics that we want to study is a simple 'matching mechanism' (Herrnstein 1997) in which actors seek to match the *experienced* support ratio a_{AB} with the *target* support ratio s_{AB}. An actor provides support if it improves the match between the experienced support ratio and the target support ratio. Otherwise, the actor does not provide support.

Obviously, we could use other mechanisms for behavioral dynamics based on reinforcement learning or imitation mechanisms (e.g., Camerer 2003: Chapter 6, Vega-Redondo 2003: Chapter 11). Experiences with a partner might influence behavior through 'learning'. People who were more supportive in the past may be expected to be more supportive in the future. However, it is not straightforward to apply reinforcement learning theories to the ISG. Usually, learning mechanisms are used in simultaneously played games where actors are uncertain about the outcome of a certain behavior. In the ISG, actors choose sequentially whether or not to provide support. Thus, there is no uncertainty about the direct outcome of a choice. We therefore think that simple reinforcement mechanisms are not appropriate for this study. Another behavioral dynamics could be 'imitation'. Actors learn from each other what constitutes 'appropriate' behavior, and then imitate it (e.g., Schlag 1998, Hedström 1998, Barrera and Buskens 2007). With respect to the heterogeneous ISG, dyadic imitation does not seem to be a reasonable approach since it is not convincing in our context to assume that an actor blindly imitates someone who has different incentives.

5.3.2 Actors' Target Support Ratios

In the former analyses we assumed that if actors provide support they provide full support. Thus, given it was individually rational to provide support, actors provided support every time support was needed (i.e., $\alpha_A = \alpha_B = 1$). It is important to realize that there are no clear a priori reasons to fix the α's across all parameter values, and consequently s_{AB}, in one or the other way. Therefore, we need 'principles' to derive α's in such a way that actors' consider them as their *target*.

We do not have strong arguments to prefer one principle to another for deriving a target support ratio. We choose two different principles from rather different theoretical traditions, one based on equity theory from sociology and social psychology and the other based on bargaining theory from game theory and economics. We assume that an actor follows only one principle. As discussed before, whether both actors follow the same principle or not is irrelevant for our behavioral predictions. We assume that every actor matches the experienced support ratio with the target support ratio – independent of whether actors assume their partners to follow the same principles or not.

Equity theory offers a number of different principles to specify the target support ratio (e.g., Desmarais and Lerner 1994 for a review, Adams 1965, Deutsch 1975, 1985, Walster et al. 1978). Equity principles usually focus on 'equal' distributions of 'outputs' and 'inputs', i.e., of rewards and contributions. In the context of social support we think of outputs as the benefits from received support, and of inputs as the costs of provided support. Intuitively, the most convincing principle states that 'outputs should be *proportional* to inputs' ('distributive justice', see, e.g., Van den Bos et al. 1997: 1034). For an actor *i*, the expected benefits are $b_i \pi_i \alpha_j$ per time unit and the expected costs are $c_i \pi_j \alpha_i$ per time unit. The advantage of this principle over related principles is that it takes into account heterogeneity in all individual properties, i.e., the equity-based target support ratio depends on the costs, the benefits, and the neediness of both actors. Outputs and inputs are proportional for both actors if

$$\frac{b_A \pi_A \alpha_B}{c_A \pi_B \alpha_A} = \frac{b_B \pi_B \alpha_A}{c_B \pi_A \alpha_B}.$$

Using straightforward computation, the *equity support ratio* is

$$e_{AB} = \frac{\alpha_A}{\alpha_B} = \frac{\pi_A}{\pi_B} \sqrt{\frac{b_A c_B}{b_B c_A}}. \tag{5.3}$$

The ratio e_{AB} is a function of the costs, benefits, and neediness parameters b_i, c_i, π_i. The ratio e_{AB} increases in b_A, c_B, and π_A and decreases in c_A, b_B, and π_B. Thus, actor A provides support relatively more often than actor B if A's benefits are higher and costs are smaller, and if A is more often in need.

Obviously, if actors are homogeneous in all respects ($c_A = c_B$, $\pi_A = \pi_B$, $b_A = b_B$) equity theory predicts that actors provide support equally often:

$$e_{AB} = 1.$$

As a more interesting example, if the costs of actor A ($c_A = 8$) are smaller than the costs of actor B ($c_B = 16$), while the benefits ($b_A = b_B = 32$) and neediness ($\pi_A = \pi_B = 0.5$) are homogeneous, we obtain $e_{AB} > 1$. Namely, in this case

$$e_{AB} = \frac{0.5}{0.5}\sqrt{\frac{32 \cdot 16}{32 \cdot 8}} = \sqrt{2}.$$

Consequently, out of all times B needs support actor A has to provide support $\sqrt{2}$ times more often than actor B provides support out of all the times A needs support.

The target support ratio based on *bargaining theory* is derived from the Kalai-Smorodinsky bargaining solution (Kalai and Smorodinsky 1975, Roth 1979: 103, see for a detailed discussion Weesie 2005). We present the Kalai-Smorodinsky bargaining solution for the *one-shot* Support Game. The one-shot solution is essentially the same as for the *repeated* game. Bargaining theories address how the gains from support are distributed, assuming individual rationality (i.e., no actor is worse off than in a situation where no support whatsoever is given). According to the Kalai-Smorodinsky bargaining solution, the gains from support are distributed relative to the gain that actors could maximally obtain in all possible distributions that satisfy the individual rationality constraint. If actor A *could* gain a lot from individually rational support, while actor B *could* gain only a little, actor A is predicted to obtain a lot in the Kalai-Smorodinsky bargaining solution. Whereas the derivation of the support ratio from equity theory is simple and straightforward, the derivation of the support ratio from the Kalai-Smorodinsky bargaining solution is rather elaborated and not very intuitive (see Weesie 2005). We therefore report the derivation in Appendix D. We restrict ourselves here to the case that the parameters satisfy $\frac{b_A\pi_A}{c_A\pi_B}, \frac{b_B\pi_B}{c_B\pi_A} > 1$, which is always the case in the experimental data discussed below. According to the Kalai-Smorodinsky bargaining solution, support should satisfy the *bargaining support ratio*

$$k_{AB} = \frac{\alpha_A}{\alpha_B} = \frac{\pi_A}{\pi_B} \cdot \frac{b_A c_B \pi_A + b_A b_B \pi_B}{b_B c_A \pi_B + b_A b_B \pi_A}. \tag{5.4}$$

The ratio k_{AB} is a function of b_i, c_i, and π_i. The ratio k_{AB} increases in b_A, c_B, and π_A and decreases in c_A, b_B, and π_B. In the homogeneous case that actors are homogeneous with respect to costs ($c_A = c_B$), benefits ($b_A = b_B$), and neediness ($\pi_A = \pi_B$), the Kalai-Smorodinsky bargaining solution states that actors should have the same conditional probability of giving support,

$k_{AB} = 1$.

In the more interesting example, also mentioned in regard to equity theory, if the costs of actor A ($c_A = 8$) are smaller than the costs of actor B ($c_B = 16$), while the benefits ($b_A = b_B = 32$) and neediness are homogeneous ($\pi_A = \pi_B = 0.5$) we obtain a $k_{AB} > 1$, in this case we get

$$k_{AB} = \frac{0.5}{0.5} \cdot \left(\frac{32 \cdot 16 \cdot 0.5 + 32 \cdot 32 \cdot 0.5}{32 \cdot 8 \cdot 0.5 + 32 \cdot 32 \cdot 0.5} \right) = 1.2 .$$

Consequently, A has to provide support 1.2 times more often than B, given B needs support. More numerical examples can be found in Section 5.4, which gives a description of the experimental designs.

We briefly compare the predictions of equity theory and bargaining theory. Both target support ratios, e_{AB} and k_{AB}, increase in b_A, c_B, π_A and decrease in c_A, b_B, π_B. It can be shown that the equity support ratio and the bargaining support ratio always agree on which actor has to provide support more often, and it can be shown that equity theory predicts more extreme ratios than bargaining theory, i.e., $e_{AB} \geq k_{AB} \geq 1$ or $e_{AB} \leq k_{AB} \leq 1$ (see for a more detailed discussion Weesie 2005).

5.3.3 Hypotheses

We assume that each actor tends to provide support in accordance with the target support ratio (either the equity support ratio or the bargaining support ratio) that he or she strives for. The equity support ratio and the bargaining support ratio always agree on which actor provides support more often. If $s_{AB} > 1$, i.e., $\alpha_A > \alpha_B$, then A has to provide support with a higher conditional probability than B. We label the actor who is more likely to provide support as the 'weak' actor, and the other actor as the 'strong' actor. In other words, we label the actor with the larger α the weak actor, and the actor with the smaller α the strong actor. A is the weak actor and B is the strong actor, if either $\pi_A > \pi_B$ or $b_A > b_B$ or $c_A < c_B$, assuming no difference in the other two parameters. Thus, the weak actor is the actor who is more often in need, or fears the higher loss from not receiving support, or has the lower costs of providing support.

In the beginning of an interaction, i.e., the first round of an ISG, actors cannot compare the experienced support ratio with the target support ratio. Each actor is assumed to provide support with the conditional probability that is in accordance with the actor's target support ratio and fulfills the Pareto efficiency constraint. Thus s_{AB} defines actors' behavior in the first round of an interaction. Since the conditional probability of the weak actor is larger than the conditional probability of the strong actor according to the equity support ratio as well as the bargaining support ratio, we hypothesize that the weak actor is more likely to provide support in the first round than the strong actor.

Hypothesis 5.1 (initial support): *The weak actor is more likely to provide support in the first round of a series of interactions than the strong actor.*

Turning to behavioral dynamics, we assume that actors seek to implement s_{AB} in their interaction. To do so, actors compare their experienced behavior with the behavior they strive for according to equity or bargaining theory. Actors are assumed to compare the *experienced* support ratio a_{AB} with the *target* support ratio s_{AB}. If $a_{AB} > s_{AB}$, we say that 'A provided support relatively more often than B' with respect to s_{AB}. Thus, B has to provide support more often to match the support ratio – independent of the behavior of actor A – to avoid at least the *discrepancy* of s_{AB} and a_{AB} becoming even larger. The situation is opposite for A. To match s_{AB}, A does not provide support to avoid the discrepancy between s_{AB} and a_{AB} becoming even larger. If $s_{AB} = a_{AB}$ the matching rule does not really apply. Just as in the first round, we then expect the weak actor to be more likely to provide support than the strong actor. Thus, in this case experience does not matter. Rather the individual parameters that define the target support ratio s_{AB} matter.

The discrepancy of the experienced support ratio and the target support ratio is a continuous quantity. Assuming that an actor's decision whether to provide support or not depends on this discrepancy, we hypothesize that the larger the discrepancy, the larger the probability that the actor 'who provided support relatively less often' will provide support and the smaller the probability that the actor 'who provided support relatively more often' will provide support.

Hypothesis 5.2 (dynamics of support): *The larger the discrepancy between the experienced support ratio and the target support ratio, the larger/smaller the probability to provide support in a decision situation of the actor who provided support relatively less/more often than according to the target support ratio.*

With respect to the first hypothesis, equity theory and bargaining theory always agree on the actor who needs to provide support more often, i.e., they agree on who the strong actor is and who the weak actor is. However, equity and bargaining theory do not yield the same target support ratio values. Even though the target support ratios agree on the weak and strong actor, equity theory always predicts more extreme target support ratios than bargaining theory. Thus, the theories do not coincide with respect to the predictions based on the second hypothesis.

5.4 Method

The predictions have been tested with data from two experiments. We now present the procedure and the design of the two experiments in detail.

5.4.1 Experiment 1

Experiment 1 with 148 subjects was carried out at Utrecht University, the Netherlands, in May 2004 (for a detailed description see Chapter 3).[1] Subjects played heterogeneous and homogeneous ISGs. Subjects participated in reaction to an advertisement inviting them to participate in a 'decision experiment'. Most of the participants, namely 68%, were female. Most participants were students, coming from a variety of disciplines. On average, subjects were 22 years old (sd. 3.6). The experiment was partly completed by pen and paper, and partly by computer with the software program z-Tree (Fischbacher 1999). The instructions emphasized that the payment at the end of the experiment would be in accordance with the decisions subjects had made. For each point, the subjects earned one eurocent. Additionally, subjects received a 5 euro show-up fee to guarantee a reasonable earning for participation. It was explicitly mentioned that there were no 'right' or 'wrong' decisions. Subjects were told that they could interrupt any task at any time to ask the experimenter for assistance. Subjects were assigned to role A or role B, representing actor A and actor B of the experimental design.

Conditions: We induce heterogeneity in the costs of providing support (c_A, c_B) and in the likelihoods of needing support (π_A, π_B). Heterogeneity in the costs and in the likelihood varied between two subjects playing an ISG and between conditions. The benefits did not vary between subjects playing an ISG ($b_A = b_B$), but varied between conditions. See the details of the design in Table 5.1 below:[2]

Table 5.1 Design and predictions for experiment 1.

Condition Description	π_A	π_B	c_A	c_B	$b_A = b_B$	e_{AB}	k_{AB}
C_1: Homogeneity	0.5	0.5	8	8	24	1.00	1.00
C_2: Small heterogeneity in costs	0.5	0.5	8	16	32	1.41	1.20
C_3: Big heterogeneity in costs	0.5	0.5	8	24	36	1.73	1.36
C_4: Small heterogeneity in neediness	0.6	0.4	8	8	24	1.50	1.23
C_5: Big heterogeneity in neediness	0.7	0.3	8	8	24	2.12	1.50
C_6: Small accumulation	0.6	0.4	8	16	32	2.60	1.74
C_7: Big accumulation	0.6	0.4	8	24	36	2.33	1.56
C_8: Small compensation	0.3	0.7	8	16	32	0.61	0.77
C_9: Big compensation	0.3	0.7	8	24	36	0.74	0.85

[1] The English translation of the instructions of experiment 1 is found in Appendix B.
[2] Due to consistency we use the same description of the conditions as in Chapter 3, although the conditions have not been introduced in detail in this chapter.

The rows describe the nine conditions of the experiment. Consider, for instance, C_9. Subjects in role A need support with probability $\pi_A = 0.3$. The costs of providing support in role A are $c_A = 8$ points, and the benefits in role A are $b_A = 36$ points. Subjects in role B need support with probability $\pi_B = 0.7$, thus much higher than the probability of role A. The costs of providing support are $c_B = 24$ points for role B, three times more than the costs for role A. The benefits are the same for roles A and B, namely $b_A = b_B = 36$ points. The last two columns of the table indicate the target support ratios e_{AB}, and k_{AB}. Unsurprisingly, we see that under homogeneity the target support ratios are identical $e_{AB} = k_{AB} = 1$. The label 'accumulation' for conditions C_6 and C_7 is meant to indicate heterogeneity in the sense that one of the actors (B) has two problems due to heterogeneity, namely high costs of support as well as a very needy partner. The label 'compensation' is meant to indicate that one of the actors (B) has the problem of high costs of support, while the other actor (A) has the problem of a very needy partner.[3] Note that we employ the conventional, though far from unproblematic, assumption that "utility = own points = own money." We thus neglect the possibility that an actor's utility, e.g., may depend not only on own outcomes but also on the other actor's outcomes, etc.

Indefinitely Iterated Support Game (IISG): For 15 minutes, i.e. one *part*, subjects played several IISGs with randomly selected others under *one* experimental condition. Three different parts made up one session. The entire experiment contained nine sessions. In the beginning of each IISG one subject received the role of person A and the other subject received the role of person B. The roles represent the different values of the different parameters. The roles were determined at random. Subjects could not identify the other person with whom they were playing. The continuation probability w ('common future') was set at $w = 0.8$.

Operationalization: In the beginning of each *decision situation* all subjects received certain numbers of points, i.e., endowments (benefit = b_i). All subjects were threatened to lose their endowment with a certain probability (neediness π_i). At one decision situation, either i or j were threatened to lose their endowment. If i was threatened to lose his or her endowment, j could overcome this threat by giving away a part of his or her own endowment. If j gave away a part of his or her own endowment at the costs of c_j, i overcame the threat and did not lose anything ('actor j provides and actor i receives support'). Finally, i lost the entire endowment if j did not give away a part of his or her own endowment ('actor j does not provide and actor i does not receive support').

[3] Accumulation versus compensation with respect to heterogeneity between actors matters for predictions based on a theoretical model using trigger strategy equilibria (see Chapter 3 and 4 for details). Note also that originally the experimental conditions have not been designed specifically with the aim of testing the hypotheses presented in this chapter. We return to some shortcomings of our design due to this feature in our concluding discussion.

Questionnaire: After playing the games, subjects filled in a questionnaire on some basic demographics and they were asked to evaluate a number of statements on trust, reciprocity, support, giving and receiving compliments, empathy, giving and denying help, etc. This information is not used here. In total the experiment took between 70 and 90 minutes.

5.4.2 Experiment 2

Experiment 2 was carried out at the Experimental Laboratory for Sociology and Economics (ELSE) at Utrecht University, the Netherlands, in October 2005 (for a detailed description see Chapter 4).[4] As in experiment 1, actors played homogeneous and heterogeneous ISGs. Subjects were recruited through a database of subjects willing to participate in experiments (ORSEE, Greiner 2004). In total, 100 subjects participated in the experiment. On average, the age of the subjects was 21 years old (sd. 5.1), and 62% of them were female. Most subjects were undergraduates from Utrecht University. The experiment was conducted using z-Tree software (Fischbacher 1999). The subjects could not see each other or each other's computer screens during the experiment. The experimenter and an assistant were always present in the laboratory to answer any questions that the subjects had.

To make the support situations more realistic, the subjects' behavior during the experiment determined how much they would earn. Before subjects started the experiment they received an endowment of 1000 points which is equivalent to 10 euros. Each point that subjects gained or lost was equivalent to 1 eurocent. In the beginning of each interaction subjects received role A or role B, representing actor A and actor B of the experimental design. The difference between the two experiments is that in experiment 1, subjects could only be threatened with a loss of points, whereas in experiment 2 they also have the opportunity to gain points. Furthermore, in experiment 1 the ISGs continued with a certain probability (0.8), whereas in experiment 2 every Support Game ends after exactly five rounds, thus, subjects play *finitely* ISGs (FISG). Further differences can be seen among the conditions of the two experiments.

Conditions: We compare homogeneity in neediness ($\pi_A = \pi_B = 0.5$) with heterogeneity in neediness ($\pi_A = 0.3$, $\pi_B = 0.7$). We use $b_A = b_B = 24$ and $c_A = c_B = 8$ throughout, see Table 5.2 below. Both conditions can be found in experiment 1.

Table 5.2 Design and predictions for experiment 2.

Condition Description	π_A	π_B	c_A	c_B	$b_A = b_B$	e_{AB}	k_{AB}
$C_{T/O1}$: Homogeneity	0.5	0.5	8	8	24	1.00	1.00
$C_{T/O2}$: Big heterogeneity in neediness	0.7	0.3	8	8	24	2.12	1.50

[4] The English translation of the instructions for experiment 2 is found in Appendix C.

The experiment contained four conditions: C_{O1}, C_{O2} run as opportunity situations, C_{T1}, C_{T2} run as threat situations (see *operationalization* below).

Finitely Iterated Support Game (FISG)*:* The subjects played two-persons FISGs. In the beginning of each FISG subjects were randomly matched with other subjects, and randomly received role A or B. Each FISG took 5 rounds, i.e., 5 decision situations. Each subject played twelve FISGs (6 FISGs in terms of opportunities, and 6 FISGs in terms of threats, see operationalization below). In half of the FISGs, a subject had role A. Subjects knew the parameters of the game (b_i, c_i, π_i), the number of FISGs to be played and the number of rounds per FISG.

Operationalization: The subjects were not only threatened with a loss of points, they also had the opportunity to gain points (note that subjects now start the FISGs with an endowment of 1000 points, rather than receiving a small endowment before every decision situation): in an opportunity situation, all subjects had the chance to receive a certain number of extra points with a given probability ('neediness'). In one decision situation, either role A or role B had the opportunity to gain additional points (b_i = 24). The other half of the subjects could seize this opportunity for their game partner by giving away a part of their own endowment (c_j = 8). A subject received the additional gain if his or her partner gave away a part of his or her own endowment ('actor *j* provides and actor *i* receives support'). Consequently, a subject did not receive the additional gain if the partner did not give away a part of his or her own endowment ('actor *j* does not provide and actor *i* does not receive support'). The operationalization of being threatened to lose points is in accordance with the operationalization of experiment 1.

Questionnaire: The experiment consisted of three parts. First, subjects' risk preferences were assessed. Second, subjects played a number of FISGs. Third, a questionnaire about possible relevant background variables on social support was filled in. We do not use the risk assessment and the questionnaire here, since the second part is sufficient to test our hypotheses. The duration of the entire experiment was between 45 and 60 minutes.

5.5 Results

We analyze, first, whether subjects initiate support relations are in accordance with the target support ratios as predicted by equity theory and bargaining theory in the first round. Second, we analyze whether actors follow the proposed behavioral dynamics, namely matching of the experienced support ratio and the target support ratio.

5.5.1 Initial Support

Table 5.3 reports the experienced support ratio a_{AB} in the first round of the FISG/IISG. Considering only the first round allows us to exclude how people adjust their behavior to experience. We test whether the weak actor is more likely to provide support in the first round of an interaction. The first column of Table 5.3 specifies the different experimental conditions of experiments 1 and 2 (see Table 5.1 and Table 5.2). The following two columns contain the percentages of support provided in the first round for subjects in roles A and B. The next column shows the experienced support ratio, i.e., the percentage of support provided by role A in the first round divided by the percentage of support provided by role B, $a_{AB} = \frac{\text{% provided support A}}{\text{% provided support B}}$. If $a_{AB} > 1$, then A provided support more often than B, given the other actor needed support in the first round. The next two columns report predictions (e_{AB}, k_{AB}) of target support ratios. If e_{AB}, $k_{AB} > 1$, A is the weak actor and is more likely to provide support than B. As we mentioned before, equity theory and bargaining theory make the same predictions about whether A or B is more likely to provide support in the first round, however, the predictions of equity theory are more extreme. The following four columns report the results of the tests described in the following paragraph.

The test on whether experienced support ratios correspond with predicted target support ratios, a non-linear Wald test, is used on the parameter estimates of a logistic regression with random subject effects and fixed effects for conditions times role. First, we focus on the data of experiment 1. With two exceptions (C_8, C_9), the actor who actually provides support more often is the weak actor, i.e., the actor who, according to our predictions, has to provide support more often. This holds true for bargaining and for equity theory. The nonlinear Wald tests finds significant differences between some of the theoretical point prediction and the data. For equity theory a significant difference is found between the experienced and the target support ratios for three conditions, (C_4, C_7, C_8). For bargaining theory a difference between the predicted and the experienced ratios is found in only one condition, C_4. Note that in C_8 and C_9, the observed weak role is different from the expected weak role. However, the difference is only significant in C_9. We note that the number of observations and decisions, and hence the power of the test, is low. In experiment 2 there is a difference between the experienced and the predicted target support ratios in C_{T2} and C_{O2}, i.e., for equity theory under opportunity and threat. However, only under opportunity (C_{O2}) is a significant difference between the experienced and the predicted target support ratio for bargaining theory. Generally, we can conclude that in most cases both theories correctly predict the weak actor to be more likely to provide support. In most cases k_{AB} is closer to the experienced support ratio than e_{AB}. Equity theory predicts more extreme target support ratios than bargaining theory does, and these more extreme target support ratios seem to exaggerate the differences due to heterogeneity. As stated before, this holds theoretically true in general, not just in these experimental conditions. We discuss this point testing the behavioral dynamics.

Table 5.3 Nonlinear Wald tests for point predictions. Percentage of provided support by A and B and (in parentheses) the number of decisions in round 1.

Conditions	Data			Predictions		Wald test equity		Wald test bargaining	
	A	B	α_{AB}	e_{AB}	k_{AB}	Chi2(1)	p-value	Chi2(1)	p-value
Experiment 1									
C_1: Homogeneity *c, π, b*	70 (69)	74 (76)	0.95	1.00	1.00				
C_2: Heterogeneity *c*	64 (28)	43 (30)	1.49	1.41	1.20	0.38	0.5397	0.92	0.3362
C_3: Large heterogeneity *c*	76 (75)	39 (69)	1.95	1.73	1.36	1.95	0.1631	3.77	0.0521
C_4: Small heterogeneity *π*	79 (43)	78 (78)	1.01	1.50	1.23	27.47	0.0000	6.34	0.0118
C_5: Large heterogeneity *π*	86 (70)	49 (89)	1.76	2.12	1.50	2.87	0.0903	0.63	0.4291
C_6: Accumulation *c & π*	59 (51)	26 (66)	2.26	2.60	1.74	0.01	0.9101	1.17	0.2802
C_7: Accumulation *c & π*	77 (48)	55 (122)	1.40	2.33	1.56	12.11	0.0005	0.00	0.9937
C_8: Compensation *c & π*	78 (42)	75 (24)	1.04	0.61	0.77	6.14	0.0132	2.55	0.1100
C_9: Compensation *c & π*	74 (27)	28 (18)	2.64	0.74	0.85	2.09	0.1485	1.93	0.1644
Experiment 2									
C_{T1}: Homogeneity *c, π, b*	86 (72)	86 (72)	1.00	1.00	1.00				
C_{T2}: Large heterogeneity *π*	89 (87)	59 (69)	1.51	2.12	1.50	16	0.0001	0.00	0.9473
C_{O1}: Homogeneity *c, π, b*	90 (81)	89 (81)	1.01	1.00	1.00				
C_{O2}: Large heterogeneity *π*	82 (74)	83 (64)	0.99	2.12	1.50	209	0.0000	42	0.0000

The joint nonlinear Wald test for the point predictions is significant for equity theory (chi2(8) = 54.30, $p < 0.001$) and barely significant for bargaining theory (chi2(8) = 16.75, $p = 0.033$).

However, these are point predictions. While the data are reasonably consistent with bargaining theory, this of course does not prove that bargaining theory is correct. To illustrate, we also test the null hypotheses $s_{AB} = 1$, i.e., independent of the differences in costs, benefits, and neediness the target support ratio is to provide support equally often (we refer to it as the equality model). The joint test for all conditions is again significant (chi2(8) = 24.59, $p < 0.001$), but is not much different from bargaining theory. In experiment 2 the joint test for all conditions is highly significant for equity theory (chi2(2) = 224.74, $p < 0.001$) as well as for bargaining theory (chi2(2) = 41.97, $p < 0.001$). In experiment 2 the experienced support ratio is the closest to the ratio where both actors provide support equally often (chi2(2) = 9.48, $p = 0.0087$). If we only consider the conditions under ‘threat’, the difference between the experienced support ratio and the target support ratio is nonsignificant for bargaining theory. However, in the opportunity conditions actors start providing support with equal probabilities. Our main conclusion is that the target support ratios and the experienced support ratios agree on the weak actor being the more supportive one and that bargaining theory offers somewhat better point predictions.

5.5.2 Dynamics of Support

We now address the behavioral dynamics and tests of the hypothesis that the larger the discrepancy between the experienced support ratio a_{AB} and the target support ratio s_{AB}, the more/less likely the actor who provided support relatively less/more will also provide support in the next decision situation, given the other actor needs support. We use a logistic regression analysis with random subject effects (see Fischer 1997, or Chapter 3 for a detailed discussion with respect to the ISG). The discrepancy between the experienced and the target support ratio will be modeled as follows:

$$\textit{Logit (Prob that i provides support in condition l, at time t)} = c_l + \beta D_{ilt} + controls + u_i .$$

With c_l we specify the conditions (l runs over conditions by role with homogeneity as reference), and with u_i we specify the subject effect. As control variables, we added dummies for the experimental treatments within an experimental session as well as IISG/FISG within treatments. D_{ilt} denotes the discrepancy of the experienced support ratio $a_{AB} = \frac{p_A}{p_B}$ and the target support ratio $s_{AB} = \frac{\alpha_A}{\alpha_B}$. Note that p_i = (number of times *i* supported *j*)/(number of times *i* *could have* supported *j*) is not determined if the number of times *i could have* provided support is zero. We therefore assume that in case the number of times *i could have* provided support is zero, the entire term is zero, i.e., $p_i = 0$. However, we furthermore modify the ratio $\frac{p_A}{p_B}$ to avoid undefined cases in situations where actor B not yet has provided support or has not yet had the opportunity to provide support. To avoid such undefined cases, we add actor A and B's conditional probability of providing support (α_A, α_B).[5] Thus, we model the discrepancy in such that

$$D_{ilt} = \left(\frac{p_A + \alpha_A}{p_B + \alpha_B} - \frac{\alpha_A}{\alpha_B} \right).$$

In Table 5.4, we present the random effect logistic regression models of the data of experiment 1 for equity theory and bargaining theory in two different models, Model 1 (EQUITY) and Model 2 (BARGAINING). The effect of the discrepancy of the experienced and the target support ratios is highly significant and positive just as we predicted. This holds true for equity and for bargaining theory. Thus, the larger the discrepancy between the experienced and the target support ratio, the larger the support probability will be in the next decision situation of the actor who provided support relatively less often out of all times he or she could have provided support.

[5] Note that (α_A, α_B) are set to the Pareto-efficient solution, i.e., $\alpha = 1$ for larger α.

Table 5.4 Logistic regression with random subject effects for experiment 1. Saturated with respect to conditions and roles, fitted by maximum likelihood.

	Experiment 1			
Social Support	M1: equity coef (se)	M2: bargaining coef (se)	M3: equity coef (se)	M4: bargaining coef (se)
Discrepancy	0.415 (0.057)	0.694 (0.078)	1.368 (0.293)	1.373 (0.294)
Discrepancy - weak actor			0.404 (0.361)	0.227 (0.354)
Discrepancy - strong actor			-1.124 (0.299)	-0.942 (0.306)
Conditions				
(homogeneity reference)				
Role A				
C_{2A}: A = weak, B = strong	-0.845 (0.341)	-0.843 (0.344)	-0.892 (0.345)	-0.850 (0.346)
C_{3A}: A = weak, B = strong	-1.033 (0.254)	-1.028 (0.255)	-1.048 (0.256)	-1.008 (0.257)
C_{4A}: A = weak, B = strong	-0.851 (0.318)	-0.882 (0.321)	-0.991 (0.323)	-0.948 (0.323)
C_{5A}: A = weak, B = strong	0.524 (0.191)	0.539 (0.192)	0.468 (0.195)	0.535 (0.194)
C_{6A}: A = weak, B = strong	-0.884 (0.355)	-0.880 (0.357)	-0.900 (0.357)	-0.871 (0.358)
C_{7A}: A = weak, B = strong	-0.875 (0.317)	-0.899 (0.320)	-1.105(0.323)	-1.026 (0.323)
C_{8A}: B = weak, A = strong	-0.853 (0.304)	-0.869 (0.306)	-0.876 (0.306)	-0.895 (0.307)
C_{9A}: B = weak, A = strong	-0.452 (0.257)	-0.424 (0.258)	-0.480 (0.258)	-0.460 (0.259)
Role B				
C_{2B}: A = weak, B = strong	-1.374 (0.342)	-1.418 (0.345)	-1.357 (0.345)	-1.390 (0.346)
C_{3B}: A = weak, B = strong	-1.757 (0.260)	-1.815 (0.262)	-1.707 (0.262)	-1.755 (0.264)
C_{4B}: A = weak, B = strong	-0.838 (0.301)	-0.853 (0.303)	-0.827 (0.303)	-0.848 (0.305)
C_{5B}: A = weak, B = strong	-0.765 (0.162)	-0.803 (0.162)	-0.749 (0.162)	-0.780 (0.163)
C_{6B}: A = weak, B = strong	-2.595 (0.367)	-2.635 (0.370)	-2.526 (0.368)	-2.560 (0.370)
C_{7B}: A = weak, B = strong	-1.208 (0.298)	-1.261 (0.301)	-1.209 (0.300)	-1.256 (0.302)
C_{8B}: B = weak, A = strong	-0.810 (0.338)	-0.857 (0.340)	-1.106 (0.345)	-1.025 (0.345)
C_{9B}: B = weak, A = strong	-1.097 (0.324)	-1.157 (0.326)	-1.445 (0.340)	-1.384 (0.337)
Treatment 2	0.151 (0.116)	0.149 (0.117)	0.136 (0.118)	0.141 (0.118)
Treatment 3	0.293 (0.119)	0.294 (0.119)	0.296 (0.120)	0.295 (0.120)
IISG within treatment	-0.006 (0.015)	-0.007 (0.015)	-0.010 (0.015)	-0.010 (0.015)
constant	0.691 (0.215)	0.694 (0.217)	0.680 (0.217)	0.686 (0.218)
Statistics				
AIC	5599.583	5571.803	5537.741	5538.693
N	4683	4683	4683	4683
df_m	20	20	22	22
Model Chi2	211.387	233.335	253.162	253.963
Loglikelihood	-2777.792	-2763.901	-2744.871	-2745.347

We furthermore studied, but do not show in detail, whether non-linear effects of discrepancy can be found, but the quadratic models with respect to equity and bargaining theory do not yield better fitting models. The same holds true for the interaction between conditions by role and the discrepancy. Additionally, we studied whether the effect of the discrepancy is the same for the strong and the weak actor. Model 3 (EQUITY) and Model 4 (BARGAINING) report the results. We find a highly significant negative effect of the interaction between the discrepancy and the actor being strong, whereas the effect of the interaction between the discrepancy and the actor being weak is positive and nonsignificant. This applies to equity theory and to bargaining theory. Thus, the effect of the discrepancy is systematically less for the strong actor than predicted. Or, in other words, the weak actor is more concerned about the discrepancy than the strong actor.

Table 5.5 contains a comparable analysis of the data of experiment 2. Model 5 (EQUITY) and Model 6 (BARGAINING) are comparable to the saturated models of experiment 1. The fully homogeneous condition under threats has been taken as the reference category, comparable with the reference category in experiment 1. Our prediction is again confirmed. The larger the discrepancy, the more supportive the actor who provided support relatively less often is. The quadratic models with respect to equity and bargaining do not yield better fitting models; neither do the models of the interaction between conditions by role and discrepancy. Again, the effect of the discrepancy is systematically less for the strong actor, see Model 7 (EQUITY) and Model 8 (BARGAINING), in comparison to the weak actor.

Table 5.5 Logistic regression with random subject effects for experiment 2. Saturated with respect to conditions and roles, fitted by maximum likelihood.

	Experiment 2			
Social Support	M5: equity coef (se)	M6: bargaining coef (se)	M7: equity coef (se)	M8: bargaining coef (se)
Discrepancy	0.597 (0.061)	0.899 (0.085)	1.195 (0.145)	1.195 (0.145)
Discrepancy - weak actor			-0.419 (0.322)	-0.288 (0.313)
Discrepancy - strong actor			-0.741 (0.158)	-0.472 (0.178)
Conditions				
(homogeneity threat reference)				
C_{T2A}: A = weak, B = strong	-0.041 (0.185)	-0.008 (0.186)	-0.029 (0.188)	0.004 (0.187)
C_{T2B}: A = weak, B = strong	-0.416 (0.175)	-0.501 (0.175)	-0.395 (0.175)	-0.476 (0.175)
C_{OAB}: Homogeneity	0.076 (0.134)	0.080 (0.135)	0.082 (0.136)	0.082 (0.136)
C_{O2A}: A = weak, B = strong	-0.075 (0.180)	-0.062 (0.180)	-0.072 (0.187)	-0.048 (0.184)
C_{O2B}: A = weak, B = strong	-0.258 (0.170)	-0.361 (0.169)	-0.265 (0.169)	-0.354 (0.169)
Treatment 2	0.001 (0.083)	0.001 (0.084)	0.007 (0.084)	0.005 (0.084)
FSG within treatment	-0.082 (0.024)	-0.079 (0.025)	0.075 (0.025)	-0.074 (0.025)
constant	0.587 (0.173)	0.560 (0.174)	0.532 (0.175)	0.531 (0.175)
Statistics				
AIC	3680.608	3663.445	3661.154	3660.364
N	3000	3000	3000	3000
df_m	8	8	10	10
Model Chi2	125.193	139.791	144.361	144.698
Loglikelihood	-1830.304	-1821.722	-1818.577	-1818.182

Based on a comparison of Akaike's information criterion (AIC), we see that the model without the interaction of discrepancy, with weak and strong actors and based on bargaining theory fit the data better than the ones based on equity theory. This holds true for experiments 1 and 2. However, comparing equity and bargaining with the available data is difficult. Recall that both theories always predict the same weak actor and the same strong actor; the differences are quantitative rather than qualitative. Furthermore, we note that the model fits are generally very similar, which is due to a high correlation between equity support ratio and bargaining support ratio (0.9855 in experiment 1, and 0.9749 in experiment 2). Still, the fact that the effect of the discrepancy on the strong actor is somewhat weaker under bargaining than under equity theory, in combination with the better fit suggests that bargaining theory predicts slightly better. Furthermore, considering the equality model again, $s_{AB} = 1$, the AIC of the bargaining model (5571.803) is smaller than the AIC of the equity model (5599.583) and the equality model (5591.588) in experiment 1. In experiment 2 the AIC of the equality model (3656.205) is smaller than the AIC of the bargaining model (3663.445) and the equity model (3680.608). Again, it seems that the target support ratio of equity theory is too extreme in comparison to the experienced support ratios.

5.6 Conclusion and Discussion

In this chapter we questioned which actor provides support more often in a support relation between heterogeneous actors by studying the behavioral dynamics of social support between heterogeneous actors in durable relations. Our analysis is built on two assumptions. We assumed that actors tend to provide support in accordance with a specific target support ratio that they strive for. We furthermore assumed that actors try to match the experiences (experienced support ratio) in a durable relation with the support ratio they aim at (target support ratio). Using equity theory and bargaining theory we derived two different predictions. The target support ratio derived from equity theory reflects that actors' inputs are in proportion to their outputs. The target support ratio derived from bargaining theory reflects that gains from support are distributed relative to the utility of the feasible outcome with the most utility. Both target support ratios are functions of the individual parameters such as the benefits from receiving support, the costs of providing support, and neediness. We hypothesized that the 'weak' actor, i.e., the actor who has to provide support more often, is more likely to provide support in the beginning of an interaction (first round). Both theories predict the same actor to be most supportive. We furthermore hypothesized that the larger the *experienced* support ratio in comparison to the *target* support ratio, the more/less likely the actor who provided support relatively less/more often to provide support in the next decision situation.

The hypotheses have been tested by data from two experiments. Although we do find differences between the target support ratio and the experienced support ratio with respect to the first round in both data sets, we want to stress that these differences are small, especially for bargaining theory. The point predictions do not fit precisely, but especially bargaining theory fits reasonably well. We therefore conclude that bargaining theory and equity theory correctly predict which actor provides most support in the first round. Furthermore, the hypothesis on the behavioral dynamics is confirmed for equity and bargaining theory in both data sets. Interestingly, the effect of the discrepancy between the experienced and the target support ratio is stronger for the weak actors than for the strong actors, i.e., the weak actor is more concerned about the target support ratio than the strong actor. The reason for this can be that that the strong actor more easily deviates from the target support ratio, since the strong actor has to provide support relatively less often. Thus, the strong actor is more likely to provide support 'too often' than the weak actor. Another reason can be that the weak actor is more concerned about the target support ratio because he or she has more to lose from not receiving support, or because the weak actor is more often in need and consequently more interested in supportive behavior, as stated by the target support ratio.

The model based on bargaining theory has a somewhat better model fit than the one based on equity theory. When controlling for the interaction of discrepancy with the weak/strong actor, the difference in the model fit decreases and the model fit of both models becomes more similar. Bargaining theory based on the less extreme support ratios leads to slightly better predictions than equity theory. Since the support ratio based on bargaining theory is generally less extreme than the support ratio based on equity theory, this can be interpreted such that subjects do not strive for support ratios that are 'too extreme'. However, since the target support ratios of both theories are highly correlated and the predictions of both theories are pretty similar under the used experimental conditions, we are hesitant to conclude that bargaining theory is really the better theory.

A final point related to the target support ratios is that we did not consider 'efficiency' in this chapter. We only focus on the *distributional* aspect of social support. Mutual support is Pareto superior over no support at all, and efficiency can be improved if one of the actors continually provides support. Considering s_{AB} it becomes clear that we do not study efficiency in actors' behavior, since we only study support in relative terms, not in absolute terms. We only focus on the ratio of the conditional probabilities of both actors. However, if the conditional probabilities are both smaller than 1, both actors would be better off providing support more often, and this can be accomplished without changing the target support ratio. It would be interesting to test whether additionally to the distributional aspect, subjects take 'efficiency' in a heterogeneous support relation into consideration.

It would have been better to test the hypotheses with experimental conditions that lead to more extreme differences in the target support ratios of bargaining and equity theories than the one in the used data sets. Using data based on experimental conditions that were actually not designed for the hypotheses of this chapter (see Chapters 3 and 4), we did not have this option. A design that includes even more extreme equity support ratios in comparison to bargaining support ratios might have lead to an even sharper drop of the model fit of the model based on equity theory. Furthermore, it would be interesting to find other principles to predict target support ratios that do not necessarily agree on which actor shall provide support more often with the target support ratios based on equity and bargaining theory. However, so far we have not managed to develop an alternative principle that seems reasonable to us.

Theoretically, we do not expect that it matters whether actors assume their partners to aim at the same target support ratio or not. Actors seek to implement their own target support ratio. However, it may well be that actors also adjust their aim to their partner's aim, i.e., they adjust their own target to their support partner's target. In this case, actors need to learn about each other's target support ratio. We would then expect actors in the beginning of an interaction to behave in line with their own target support ratio, but through the ISG we expect them to 'update' their target support ratio by 'learning' about the opponent's concept of a target support ratio. Thus, next to adjusting the target support ratios we could replace the matching rule by a more advanced learning mechanism. A test of the discrepancy based on a learning mechanism can provide additional insight on how actors implement the target support ratios in their common experiences.

Chapter 6

Summary and Conclusions

6.1 Introduction

In this book, we study how the extent of mutual support depends on *heterogeneity* between actors in individual properties, such as *costs of providing support*, *benefits from receiving support*, and the *likelihood of needing support*. Social support occurs in various situations. Examples are colleagues helping each other at work, women taking care of each other's children, or students lending books to each other (e.g., Blau 1964: 88). In the introductory chapter we discuss the example of two neighbor women, Ms. Morgenstern and Ms. Neumann. Both women work part-time and can help each other from time to time to take care of each other's children while the other is working. Both women work as stand-by nurses in a hospital. The women differ in the bonuses they receive for their work. Ms. Morgenstern has a higher bonus because she works in the intensive-care unit, i.e., Ms. Morgenstern has higher benefits from receiving support. Moreover, Ms. Morgenstern's child is older than Ms. Neumann's. Consequently, Ms. Morgenstern's costs of providing support are higher. Finally, Ms. Neumann and Ms. Morgenstern also differ with respect to how often they are called in by the hospital, i.e., they differ with regard to the likelihood of needing support. These situations have a common structure. One day Ms. Morgenstern may be in need of support and Ms. Neumann may provide support to Ms. Morgenstern at certain costs to Ms. Neumann and with certain benefits to Ms. Morgenstern. At some time in the future, the roles might be reversed. Characteristic of such a situation is, first, that receiving support is beneficial, whereas providing support is costly. Second, an actor's benefit from receiving support is higher than that actor's cost of providing support.

This study follows rational choice theory and social exchange theory by assuming that providing support is a result of incentive-guided behavior (e.g., Homans 1961, Blau 1964, Becker 1981, Coleman 1988, Cook and Levi 1990, Molm 1990, Voss 2001, Raub and Buskens 2006). We assume that an actor's choice whether or not to provide support depends on the individual properties of both actors such as the costs of providing support, the benefits from receiving support, and the likelihood of needing support. Social support is analyzed in this study at the *dyadic level*. Following rational choice theory, applied to interdependent behavior, we assume that actors' supportive behavior depends on their own and their partner's individual properties. We then analyze whether the general level of mutual support is larger if the actors are homogeneous, rather than heterogeneous. We study heterogeneity in three individual properties, namely in the costs of providing support, the benefits from receiving support, and the likelihood of needing support. Under what *combinations* of homogeneity and heterogeneity in these individual-level properties is mutual support most likely? We furthermore study the consequences of varying the *degree* of heterogeneity in individual properties on support. The research questions of this study are:

1. *Is mutual support more likely if actors are homogeneous or if they are heterogeneous with respect to one or several individual properties?*
2. *Is mutual support more likely if actors are heterogeneous with respect to one individual property or if they are heterogeneous with respect to several individual properties? Do heterogeneous individual properties interact, and if so, how?*
3. *Does an increase of heterogeneity in one or several individual properties between the actors lead to more or less mutual support?*

One important issue in studying heterogeneity is how to *compare* homogeneity and heterogeneity. If the homogeneous actors, for instance, have higher benefits on average than the heterogeneous actors, the comparison of homogeneity and heterogeneity becomes ambiguous. The effect of heterogeneity and the effect of the increase of the 'total amount' of the benefits, i.e., of the incentives of providing support, are then confused. We can compare Ms. Neumann and Ms. Morgenstern both having a bonus of 150 euros per week with Ms. Morgenstern having a bonus of 125 euros and Ms. Neumann having a bonus of 175 euros. With respect to the effects of heterogeneity, it is less interesting to compare the homogeneous bonuses of 150 euros each with Ms. Morgenstern receiving a bonus of 150 euros per week and Ms. Neumann of 175 euros. If the general level of mutual support is higher in the latter case, is this due to the increase in heterogeneity between the women, or due to the increase of the 'total amounts' of the benefits from 300 to 325 euros? Most of the literature on 'similarity and social support' or 'asymmetric social dilemmas' mentioned in the introductory chapter does not carefully distinguish the effects of heterogeneity in actors' incentives from a 'general' increase or decrease of actors' incentives on mutual support (Schellenberg 1964, Sheposh and Gallo 1973, Murninghan and King 1992). Consequently, these studies provide at best ambiguous answers to the research questions mentioned above. Moreover, the literature on similarity and social support usually focuses on heterogeneity in only one individual property or on 'additive' effects of multiple forms of heterogeneity. Based on our game-theoretic analysis we additionally study whether heterogeneity in *several* individual properties *interacts* with each other and whether this interaction has a positive or a negative effect on social support. As shown in Chapter 2, there are nontrivial interaction effects of heterogeneity in a second individual property, such that heterogeneity in two individual properties can facilitate as well as hamper mutual support.

We use game-theoretic modeling in order to study the effects of heterogeneity on social support. We analyze a particular game, the Iterated Support Game, derive a theoretically prominent equilibrium, and use comparative statics to predict the optimal conditions of mutual support, i.e., under what distributions of the individual properties between actors is the general level of mutual support maximal. The Iterated Support Game is used as a template for the experimental tests of this study. In Section 6.2, we summarize the theoretical and empirical research from Chapters 2 until 5. In Section 6.3, we finally discuss the limitations of this study, and future research.

6.2 Summary and Conclusions on Theory and Empirical Findings

In Chapter 2, we introduce and analyze the Iterated Support Game. We summarize the theoretical model and its analysis in somewhat more detail than in the other chapters. The Iterated Support Game is a variant of the repeated Prisoner's Dilemma Game. Receiving support is beneficial, and providing support is costly. Every actor has an incentive not to provide support, but would like to receive support. Mutual support is efficient if the benefits that actors gain from receiving support are larger than their costs of providing support – assuming for simplicity that both actors are equally often in need of support. We derive the equilibrium condition for mutual support in the Iterated Support Game based on trigger strategies. An actor using a trigger strategy is never the first to refuse support, but after the other actor refused support even once, the actor using a trigger strategy never forgives and refuses support from that time on. According to the equilibrium condition, it is individually rational from the perspectives of *both* actors to provide support if their common future is 'large enough'. What 'large enough' is depends on the individual properties such as the costs of providing support, the benefits from receiving support, and the likelihood of needing support of both actors, as well as on the duration of the support relation. More technically spoken, the equilibrium condition depends on the 'continuation probability' w of the Iterated Support Game and on the 'individual conditions' of both actors. The 'individual condition' of an actor depends on that actor's costs, benefits, and likelihood of needing support, as well as on the support partner's likelihood of needing support. According to the equilibrium condition, it is individually rational to provide support if the individual conditions of *both* actors are smaller than the continuation probability of the relation. We consider as an example an interaction between Ego and Alter. If the individual condition is met for Alter, but not for Ego, then it is not individual rational for *both* actors to provide support. Thus, in our analysis, either both actors provide support or neither of the actors provides support. While we study heterogeneous actors, our analysis assumes that actors use the same strategies in equilibrium; this issue is reexamined in Chapter 5. Using comparative statics of the equilibrium condition, we analyze whether social support is more likely under homogeneity or heterogeneity. Since we are interested in social support at the dyadic level, the comparative statics are relatively complex. We derive several hypotheses.

First, if there is homogeneity in all but one individual property, homogeneity in the remaining individual property leads to the optimal condition for social support. If Ms. Morgenstern and Ms. Neumann are homogeneous in regard to their benefits from receiving support and their likelihood of needing support, social support would be most likely if they are also homogeneous with respect to the costs of providing support. Thus, social support is more likely under homogeneity in all individual properties than under heterogeneity in one individual property – this is a common empirical finding in studies of similarity and social support (see Chapter 1).

Second, heterogeneity in two individual properties can interact positively (compensation) or negatively (accumulation). If there is heterogeneity in some individual property, social support is most likely if there is a specific heterogeneous distribution of the other individual property that 'compensates' for the original heterogeneity. Furthermore, given heterogeneity in one individual property, adding heterogeneity in the other individual property can also 'accumulate' with the original heterogeneity to make social support even less likely. The intuitions underlying these interactions are such that, under compensation, the two actors in a support relation share two 'problems' in such a way that these 'problems' compensate each other. For instance, Ms. Neumann has the problem of higher costs, whereas Ms. Morgenstern has the problem of lower benefits. An accumulation of heterogeneity can be interpreted such that one actor has two problems. Ms. Neumann now has two problems, namely the higher costs of providing support and the lower likelihood of needing support. In this case, providing support is relatively costly for Ms. Neumann and Ms. Morgenstern is most often in need of support. This configuration is relatively bad for the level of social support. Please note that this intuition is limited. We do not suggest that cooperation 'problems' are to be shared: in problems of cooperation, it is in each actor's interest to solve the other actor's problems. In this sense, problems are social, not individual. We hypothesize more support under optimal compensation than under heterogeneity in one individual property. Whereas, if heterogeneity in one individual property is added to heterogeneity in another individual property, such that they accumulate, support is more likely under heterogeneity in one individual property than under accumulated heterogeneity.

Third, social support is most likely if the actors are fully homogeneous. Thus, the optimal situation for mutual support would be if the women were homogeneous with respect to the costs of providing support, the benefits from receiving support, and the likelihood of needing support, i.e., their children are of the same age, both women receive the same bonuses, and both are equally often called in by the hospital. Note that social support among fully homogeneous actors is more likely than any 'compensated' heterogeneity in several individual properties. A good intuition can be obtained from the analogy of how to make a chain out of copper, iron, and zinc as strong as possible. This is achieved by distributing the materials equally between all links, since the chain is as strong as the weakest link.

Finally, the effect of an increase of the *degree* of heterogeneity on social support differs between heterogeneity in one and several individual properties. The more heterogeneity in one individual property, the less likely is mutual support. The same holds true for accumulative heterogeneity in two individual properties. However, given compensating heterogeneity in two individual properties, more heterogeneity can facilitate mutual support – at least as long as the two heterogeneous individual properties do not yet compensate each other optimally. If the compensation is optimal, *more* heterogeneity again hampers mutual support.

We see that the interaction effects of heterogeneity in two individual properties are not trivial. Most literature on homogeneity and social support, implicitly or explicitly, assumes that the more heterogeneous the actors are, the less likely social support is. This approach ignores the possibility of compensation of heterogeneity in two individual properties. Adding heterogeneity or increasing heterogeneity does not necessarily make mutual support more difficult. Given heterogeneity in one individual property, adding heterogeneity in another individual property may actually enhance social support, given the additional heterogeneity is properly aligned with the original heterogeneity. Furthermore, increasing heterogeneity towards optimal compensation facilitates mutual support. We therefore claim that it is not sufficient to *additively* study the effects of heterogeneity in several variables (see Chapter 1 for a detailed discussion). It is important to consider interaction effects between heterogeneity variables.

Chapter 3 presents experimental tests of the game-theoretic predictions of Chapter 2. In a laboratory experiment, subjects played several Iterated Support Games. Heterogeneity is modeled in the costs of providing support and the likelihood of needing support. It is sufficient to model heterogeneity in two individual properties to test the hypotheses. The experimental setting was such that in the beginning of every interaction situation, subjects received a certain endowment. At every time point, half of the subjects were threatened to lose their entire endowment. The other half of the subjects could prevent this by giving away some of their own endowments. The tests of the hypotheses have shown that, as predicted, the larger the maximum of both actors' individual conditions, the less likely is social support. However, the model saturated with respect to the experimental conditions fits the data considerably better than the model based on the equilibrium condition. We are therefore hesitant to conclude that the effects of heterogeneity on mutual support are sufficiently explained by the equilibrium condition of the Iterated Support Game. However, empirically, a pairwise comparison of the experimental conditions proved that mutual support between homogeneous actors differs significantly from mutual support between (reasonably) heterogeneous actors. Also, the more heterogeneous the actors are with respect to one individual property, the less likely is social support. Moreover, mutual supportive behavior is reduced if heterogeneity in the costs and neediness is accumulative. Finally, we hypothesize that the better the compensation of heterogeneity in the costs of providing support and the likelihood of needing support, the more likely is mutual support. This prediction is not supported by the data. However, the test is inconclusive due to a limited sample size. Unfortunately, the experimental design does not allow us to meaningfully compare compensative heterogeneity with heterogeneity in one individual property or with accumulative heterogeneity. It would be interesting to see whether compensative heterogeneity actually leads to more supportive behavior than accumulative heterogeneity.

Due to these limitations and to the small sample size, we are reluctant to conclude that compensative heterogeneity facilitates social support. Nevertheless, we can conclude that heterogeneity and accumulative heterogeneity have a negative effect on mutual support. To make sure that we only measure the effects of heterogeneity on the general level of support, we kept the 'total amounts' of the costs of providing support and the likelihood of needing support fixed. Thus, we can exclude the interpretation that an increase of the 'total amount' of the costs of providing support or the likelihood of needing support negatively affects mutual support rather than an increase of heterogeneity between the actors.

In Chapter 4, we distinguish two types of social support situations. Providing social support can take the form of 'preventing a threat of a loss' for somebody, as in the experiment of Chapter 3. Ms. Neumann can watch Ms. Morgenstern's child, so that Ms. Morgenstern can go to the bank to negotiate against an increase of the interest rate on her mortgage. Providing support can also take the form of 'seizing an opportunity of gain' for somebody. In this case, Ms. Neumann supports Ms. Morgenstern and watches her child, so that Ms. Morgenstern can spend an afternoon in a beauty farm that she won in the lottery. This leads to the interesting question of whether mutual support differs in opportunity and threat situations. Under risk neutrality, no differences are expected between opportunity and threat situations. If actors are risk averse or risk seeking, opportunities and threats differ for them. Kahneman and Tversky (1979) have shown that subjects are often risk seeking with respect to losses and risk averse with respect to gains (S-shaped utility). See Chapter 4 for the analysis and empirical findings on S-shaped utility. Here, we only focus on globally risk averse and globally risk seeking subjects.

Globally risk averse actors try to avoid risks. These actors are strongly motivated by the worst outcome of the opportunity and threat situations to provide support, i.e., to be threatened by a loss and not to receive support. The situation is reverse for globally risk seeking subjects. These subjects do not hesitate in taking risks. Consequently, they are strongly motivated by the best outcome of the opportunity and threat situations to provide support, i.e., to have an opportunity of an additional gain and to realize it. We expect globally risk averse subjects to be more supportive in threat than in opportunity situations, and globally risk seeking subjects to be more supportive in opportunity than in threat situations. Thus, whether mutual support is larger under opportunities or threats depends on actors' risk preferences. Finally, we return to our main research problem and analyze whether the effects of heterogeneity (in the likelihood of needing support) are the same under opportunity and threat situations. In line with hypotheses of former chapters, we hypothesize that subjects are less supportive under heterogeneity in neediness than under homogeneity in neediness. We expect this effect to be stronger the more risk seeking and the less risk averse a subject is.

The hypotheses have been tested through a computer experiment. We first measured subjects' risk preferences and then had them play Iterated Support Games under opportunities and threats. None of our hypotheses on the effect of risk preferences on mutual support under opportunity and threats has been confirmed. Only the hypothesis on heterogeneity is partly confirmed. The main reason for these disappointing results is a lack of statistical power. First, we find little variation in the subjects' risk preferences and many subjects with risk preferences close to risk neutrality. Second, the percentage of support is very high anyway in the first round, namely 84%. Considering the small variation in risk preferences as well as the high rates of support provided in the first round under opportunity and threat, evidence with respect to our hypotheses is mostly inconclusive.

In Chapter 5 we develop new theory to account for empirical findings of the former chapters. Experimental evidence of the two data sets of Chapters 3 and 4 reveals that heterogeneous actors do not support each other equally often as assumed in the equilibrium analysis of the Iterated Support Game of Chapter 2. Heterogeneous actors differ in how often they provide support. This seems intuitively reasonable, but it is not incorporated in our theory. We therefore improve and extend our theory in Chapter 5, using a behavioral game theory approach. This chapter studies the behavioral dynamics of social support between heterogeneous actors by discussing which actor provides support more often in a durable relation. Why should two actors support each other equally often although, for example, providing support is twice as costly for one of the actors than for the other? Intuitively, it is more likely that heterogeneity in costs induces the person for whom giving support is less costly to provide support more frequently than the other. If Ms. Morgenstern needs support from Ms. Neumann twice as often than the other way around, it seems reasonable that Ms. Morgenstern baby-sits Ms. Neumann's child every time Ms. Neumann needs support, but that Ms. Neumann baby-sits Ms. Morgenstern's child only every second time. Ms. Morgenstern might additionally hire a professional babysitter. In our analysis, we assume that, depending on their own characteristics and those of others, actors have a (normative) 'idea' about how often they should support others and how often those others should support them. We define this 'idea' as a ratio of the conditional probabilities of both actors to provide support, the so-called *target support ratio*. Actors compare their experiences in the form of the *experienced support ratio* with the target support ratio. Assuming that actors seek to match the target support ratio and the experienced support ratio, we can make predictions on actors' behavior. Actors are more likely to provide support if providing support leads to a better match of the experienced behavior with the target behavior. Otherwise, actors do not provide support.

One aim of this chapter is to derive different 'targets' that actors strive for, i.e., to deduce target support ratios from different theoretical approaches. Such target support ratios ideally take into consideration the heterogeneity between actors in costs of providing support, benefits from receiving support, and the likelihood of needing support. We derive target support ratios from social-psychological assumptions, such as used in equity theory, as well as from game-theoretic assumptions, such as used in bargaining theory. According to the equity support ratio, both actors shall provide support at rates such that their costs and benefits are in proportion to one another. The predictions based on the bargaining support ratio are less intuitive. Roughly speaking, the bargaining support ratio reflects that gains from support are distributed relative to the utility of the feasible outcome with the most utility. Both theories agree in their predictions on which actor provides support more often, but equity theory predicts more extreme differences. The predictions have been tested by the two laboratory experiments, described in Chapters 3 and 4. The data confirm the predictions of equity and bargaining theory for the starting of social support as well as for the dynamics. Interestingly, we find that the actor who has to provide support more often according to the target support ratio, is more concerned about the 'perfect match' of the experienced and the target support ratio than the opponent. This holds true for the bargaining and the equity model. The model fit of the bargaining model is slightly better than of the equity model. Given that equity theory always predicts more extreme target support ratios than bargaining theory, we cautiously conclude that subjects do not strive for support ratios that are 'too extreme', 'extreme' meaning that one actor provides supports much more often than the other.

6.3 Future Research

Finally, we want to discuss some limitations of our analysis and possible remedies to overcome these shortcomings. The first issue concerns the *game-theoretic analysis* of the Iterated Support Game. The theoretical part of our study mainly focuses on the analysis of trigger strategy equilibria in the Iterated Support Game. Trigger strategies are 'all or nothing' strategies, i.e., actors either provide full support or no support at all. Restricting ourselves to these equilibria has the disadvantage that we assume that actors use the same strategies. While the equilibrium condition itself reflects heterogeneity, we nevertheless conclude that this approach is not fully satisfactory. We could consider 'asymmetric' equilibria that often exist in iterated games (e.g., Kreps 1990). The disadvantage of such an extension would be that we then face a complex equilibrium selection problem. In Chapter 5, this issue is takled by applying bargaining theory to the set of equilibrium payoffs (see also Weesie 2005). Bargaining theory 'solves' the cooperation problem by assuming Pareto-efficiency. Alternatively, we could extend our analysis with factors that make strategies successful under heterogeneity, and study which (combinations of) strategies are evolutionary stable (Holland 1975, Axelrod 1984, Weibull 1995). By using evolutionary game theory and computer simulations, we could combine analyzing the extent of mutual support at the dyadic level ('size of the pie') and how often which actor provides support at the individual level ('distribution of the pie').

Our analysis considers social support between heterogeneous actors involved in durable relations, and not in encounters between strangers. In the Iterated Support Game, mutual support can be explained by reciprocity. Actors can promise each other future rewards or threaten each other with a refusal to provide support (e.g., Axelrod 1984). To explain why an actor provides support in a one-shot Support Game, additional factors such as social norms, other-regarding utilities (McClintock 1972, Liebrand 1984, McClintock and Liebrand

1988, Snijders 1996), or psychological factors such as emotions (Frank 1989) can be considered. It would be interesting to study under which conditions heterogeneity has a negative or positive effect on supportive behavior between actors who do not only care about their own outcomes.

We now discuss shortcomings of our study with respect to the *experimental design*. First, the design of the experiment in Chapter 3 does not cover the case of optimal compensation between heterogeneous individual properties. Consequently, we cannot test whether optimal compensation of heterogeneity in two individual properties leads to higher support rates than heterogeneity in one individual property or of forms of suboptimal compensation. Moreover, the design does not allow a good comparison between compensation and accumulation of the individual parameters. It would be especially interesting to compare different kinds of compensation, such as 'undercompensation', 'optimal compensation', and 'overcompensation'. Whereas in the case of 'undercompensation' the heterogeneity is not aligned in such a way that they sufficiently compensate each other, in the case of 'overcompensation' the heterogeneity to some extent accumulates rather than compensates. Our theory hypothesizes more support under 'optimal compensation' than under 'undercompensation' and least support under 'overcompensation'. Additionally, it would be interesting to explore more intensively the interaction effects of heterogeneity in two individual properties regarding the question which actor provides support more often. Intuitively, we would expect the actors to clearly behave different under accumulation than under compensation – in the case of accumulation one actor provides more support than the other one, whereas in the case of compensation we would expect actors' contributions to be more equal. Second, the experimental conditions of Chapter 5 have not been designed to study the adaptive dynamics in which behavior is chosen to match experienced and target support ratios. In particular, the experiments were not designed to compare rivaling 'theories' about target support ratios. We presented two such 'theories', one based on equity theory, the other on bargaining theory. Equity theory predicts more extreme target support ratios than bargaining theory. Since the experiments were designed for other reasons than the comparison of the equity target support ratio and the bargaining target support ratio, we do not have conditions under which these two ratios make radically different predictions. However, the statistical analysis shows that the bargaining theory model fits the data slightly better than the equity theory model, but we do not consider the evidence as conclusive. A design with more extreme differences would be needed. Moreover, it would be interesting to consider *other* theories than bargaining theory and equity theory, in particular ones that make other predictions about which actors are 'strong'. We do not discuss the experimental design of Chapter 4 here, since it has been discussed at length in Section 4.6.

In this book, we focused exclusively on heterogeneity in a *quantitative* sense and on the effects of such heterogeneity on social support. We ignore more *qualitative* heterogeneity. Consider an example of the effects of qualitative heterogeneity on equilibrium selection in bargaining situations. In a bilateral bargaining situation with homogeneous actors, an even split is a likely and obvious 'focal point' solution. Focal points are equilibria that are particularly compelling for psychological reasons (Schelling 1960, Kreps 1990). Thus, homogeneity can reduce negotiation costs. If such an 'obvious' solution exists, the partners do not have to bargain for it, and there is little chance that the negotiation will fail, and thus social support is likely in this relation. On the other hand, there are also situations where heterogeneity of actors in a qualitative sense seems to be helpful. Assume that a group of tourists has to be divided into a smaller group that is to go on an excursion by van and a larger group that is to go by bus – which takes obviously longer. Now, heterogeneity might be an advantage. If the majority of the group is German and the minority is Dutch, an obvious solution is to split the group in such a way that the Dutch tourists go by van and the German tourists by bus (unless one has the specific aim to facilitate the integration between Dutch and German tourists). Here, qualitative heterogeneity reduces bargaining costs: the feeling of connectedness between the two groups leads to an obvious solution. These examples indicate heterogeneity in a qualitative sense can lead to interesting *non-continuous* effects that we do not cover in our analysis.

Summing up: This book derives hypotheses on how heterogeneity between actors affects the general level of mutual support. Social support is assumed to be the consequence of incentive guided behavior. We study heterogeneity in individual properties such as the costs of providing support, the benefits from receiving support, and the likelihood of needing support. Theoretical and empirical research has shown that heterogeneity in one of these individual properties between the actors hampers social support. However, heterogeneity in two individual properties can interact in different ways such that heterogeneity can facilitate as well as hamper mutual support between heterogeneous actors. Moreover, the book shows that heterogeneous actors do not provide support equally often. Rather, heterogeneity in the individual properties affects which actor provides support more often.

Appendix A

Proofs of Lemma and Theorems of Chapter 2

Proof of Lemma 2.1

The game analyzed is a repeated game with infinite horizon and exponential discounting. A useful tool for this analysis is Bellmann's optimality principle of dynamic programming (Kreps 1990). Due to this principle, playing a trigger strategy is individually rational if and only if all *one-step deviations* are not profitable, i.e., do not increase payoffs. Without loss of generality, consider a deviation at time t = 0, assuming that i has to decide whether to provide support or not. Using (2.2), the expected and discounted payoff if actor i chooses to provide support at t = 0 is

$$EU(\text{provide support}) = -c_i + \theta_i \left((1-w)0 + w\frac{\pi_i b_i - \pi_j c_i}{1-w\theta_i} \right).$$

Here, $-c_i$ is the payoff of the first time providing support at time $t=0$, followed by the expected and discounted payoff for always providing support from $t=1$ onward. The expected and discounted payoff if i does not provide support at $t=0$ and, hence, support is never given between the actors, is:

$$EU(\text{not provide support}) = 0.$$

The expected and discounted payoff is 0, because a trigger strategy defects forever if the other strategy defects even once or if the trigger strategy defects itself. Thus, according to Bellman's optimality principle, a necessary and sufficient condition for a (subgame-perfect) equilibrium in trigger strategies is

$$-c_i + \frac{w\theta_i}{1-w\theta}\left(\pi_i b_i - \pi_j c_i\right) \geq 0.$$

Using some straightforward computation this is equivalent to (2.3).

Proof of Theorem 2.1 (heterogeneity in one dimension)

Without loss of generality, let $\zeta_A > \zeta_B$. Since ζ_i increases in π_i, it follows that $\pi_A > \pi_B$. If we 'take away' a certain amount of π_A from actor A, and 'give it' to actor B, the increase of π_B is the same as the amount that we took away from π_A. Hence, ζ_A decreases and ζ_B increases, while $\zeta_A > \zeta_B$ still holds provided that the amount transferred from A to B is small enough. Thus, ζ^* decreases as well. We can make such transfers, and keep decreasing ζ^*, until $\pi_A = \pi_B$, and hence $\zeta_A = \zeta_B = \zeta^*$. Analogous arguments can be given for η and θ.

Proof of Theorem 2.2 (compensation)

We consider the optimal adjustment of π. Assume $\zeta_A > \zeta_B$. We observe that ζ_i increases in π_i. If we transfer a certain amount of π_A from actor A, we have to 'give it' to actor B due to the budget constraint. Hence, ζ_A decreases and ζ_B increases. So ζ^* decreases, provided that the transfer was sufficiently small. We can make such transfers up until the point that we make $\zeta_A = \zeta_B$. Note that, in contrast to the proof of Theorem 2.1, equalization of ζ_A and ζ_B does *not* imply equalization of the π's. Analogous arguments can be given for optimal adjustments of η and θ.

Proof of Theorem 2.3 (homogeneity is globally best)

Optimality of homogeneity can be demonstrated by a convexity argument. The individual threshold ζ of Lemma 2.1 can be written in terms of the individual parameters $\alpha = (\eta, \pi, \theta)$ and the total probability π_+ that either actor A or B, but not both, needs support at any time point,

$$\zeta = \frac{1}{\theta}\frac{1}{\pi\eta + 1 - (\pi_+ - \pi)} = \frac{1}{\theta}\frac{1}{\pi(1+\eta) + 1 - \pi_+}.$$

We claim that ζ is convex in α on $A = [0,\eta_+]\times[0,\pi_+]\times[0,\theta_+]$ for any η_+ and θ_+ under the assumption that $\pi_+ = 1$. Since ζ is smooth, it suffices to show that the matrix *H* of the second order derivative of ζ with respect to α is positive definite on *A*. By straightforward computation, we have

$$H = \frac{\partial^2\zeta}{\partial\alpha\partial\alpha'} = \begin{pmatrix} \frac{2\pi^2}{\theta\psi} & \frac{\pi}{\theta^2\psi^2} & \frac{-1+\pi+\eta\pi+\pi_+}{\theta\psi^3} \\ \frac{\pi}{\theta^2\psi^2} & \frac{2}{\theta^3\psi} & \frac{1+\eta}{\theta^2\psi^2} \\ \frac{-1+\pi+\eta\pi+\pi_+}{\theta\psi^3} & \frac{1+\eta}{\theta^2\psi^2} & \frac{2(1+\eta)^2}{\theta\psi^3} \end{pmatrix},$$

with

$$\psi = 1 + (1+\eta)\pi - \pi_+ > 0.$$

A necessary and sufficient condition for positive definiteness is that all principal minors of *H* have a positive determinant (Magnus and Neudecker 1988: 24). We have

$$|H_{11}| = \tfrac{2\pi^2}{\theta\psi^3} > 0,$$

$$\left|\begin{pmatrix} H_{11} & H_{12} \\ H_{21} & H_{22} \end{pmatrix}\right| = \tfrac{3\pi^2}{\theta^4\psi^4} > 0,$$

$$|H| = 2\tfrac{2(1+\eta)\pi+\pi_+-1}{\theta^5\psi^6} > 0, \quad \text{since } \pi_+ = 1.$$

Thus, *H* is positive definite for all $\alpha \in A$. We conclude that ζ is convex on *A*.

Convexity of ζ implies that $\frac{1}{2}(\zeta(\alpha_A)+\zeta(\alpha_B)) \geq \zeta(\frac{1}{2}(\alpha_A+\alpha_B))$ for any α_i. It follows that

$$\zeta^* = \max(\zeta(\alpha_A)+\zeta(\alpha_B)) \geq \tfrac{1}{2}(\zeta(\alpha_A)+\zeta(\alpha_B)) \geq \zeta(\tfrac{1}{2}(\alpha_A+\alpha_B))$$

and so ζ^* is minimal under homogeneity, i.e., 'homogeneity is globally best'.

Remark

Under the assumption that actors discount future rewards at the same rate, $\theta_A = \theta_B$, it can be shown that homogeneity is globally best also if $\pi_+ < 1$, even though ζ^* is not globally convex. The assumption that $\pi_+ = 1$ made in Theorem 2.3 cannot be dropped in general. The assumption is made to ensure that the determinant of the Hessian of the threshold function ζ^* is positive definite, and the threshold ζ^* is convex. If $\pi_+ < 1$, the threshold ζ^* is no longer globally convex. Homogeneity need not be optimal in the part of the parameter space where convexity does not hold. First, we consider the heterogeneous example,

$$\alpha_A = (\eta_A, \pi_A, \theta_A) = (4.5174, 0.0344, 0.9348), \zeta_A = \zeta(\alpha_A) = 0.9464,$$

$$\alpha_B = (\eta_B, \pi_B, \theta_B) = (3.6751, 0.0251, 0.9997), \zeta_B = \zeta(\alpha_B) = 0.9456.$$

Thus, $\zeta^*(\alpha_A, \alpha_B) = 0.9464$.

Now, we consider the homogeneous example:

$$\alpha_A = (\eta_A, \pi_A, \theta_A) = (4.0963, 0.2975, 0.9673), \zeta_A = \zeta(\alpha_A) = 0.9466,$$

$$\alpha_B = (\eta_B, \pi_B, \theta_B) = (4.0963, 0.2975, 0.9673), \zeta_B = \zeta(\alpha_B) = 0.9466.$$

Thus, $\zeta^*(\alpha_A, \alpha_B) = 0.9466$.

In this example, homogeneity has a larger threshold than heterogeneity, and so social support is harder under homogeneity, but the difference between homogeneity and heterogeneity is very small indeed. This numerical example is illustrative of the counter examples against the claim 'homogeneity is best'. If homogeneity is not optimal, it will be *negligibly* worse than a specific heterogeneous distribution. The differences are so small that we do not anticipate that these perverse situations can be identified empirically. ζ^* is convex in (η, θ, π), not in $(\frac{1}{\eta}, \theta, \pi)$.

Appendix B

Instructions for the Experiments of Chapters 3 and 5

This appendix provides the English translation of the Dutch instructions for the experiment of Chapters 3 and 5.

Introduction

Welcome to this experiment. In this experiment, you have the possibility to earn money depending on the choices you make. Your earnings will be paid to you at the end of the experiment, privately and in cash. During the experiment you will earn points that will later be exchanged into money at the rate of 1 point = 1 eurocent. In this experiment, you are asked to make many decisions and you can earn a lot of points. Therefore, read the following instructions carefully and make your choice carefully.

These instructions contain all the information you need to complete the experiment. Therefore, you are kindly requested to remain quiet and not to ask any question, unless it is absolutely necessary. From this moment on, you should not speak with anybody in this room and you should not look at the monitors of your fellow participants. It is important for us that your decisions are completely independent and based only on the information that you received from these instructions and on what you see on the screen of your pc. There are no 'right' or 'wrong' choices.

This experiment consists of three parts. Each part takes about 15 minutes. The parts themselves consist of a number of periods. You are matched with another person for a certain number of periods. Your role and the role of the person that you are paired with differ from each other, as we will later explain. We call these roles A and B. Sometimes you are A, and someone else is B. Sometimes you are B, and someone else is A. In each period, you or the person you are matched with is asked to make a decision, and this decision has consequences for both of you. During the whole experiment you are asked to make similar kinds of decisions. Some details may change, as we will later explain.

The period of time that you are matched with someone is determined at random by the computer. The computer also determines your role. Your role can only change if you are re-matched with another person. During the entire experiment you are matched with several different other persons. The computer always informs you if you have been re-matched, and if you change roles. Neither during nor after the experiment will you be told whom the other persons are that you have been matched with.

The Choice
Every person gets 20 points per period. We will take points away from a number of randomly chosen persons. The persons with whom they are matched can overcome this, by giving away some of their own points. They do not have to give away points; this is their own decision. Below are the details of the choice situation as you will see them on the computer screen.

The numbers are only examples!

With whom are you matched?
First the computer draws a number between 1 and 4. If a 4 has been drawn all persons will be re-matched, and roles might change. If a 1 to 3 has been chosen everything stays the same.

What happens in one period?
Every person receives 27 points. Subsequently, the computer draws a number between 1 and 10.

If the computer draws a number smaller or equal to 6, A is threatened to lose his or her points for this period. B can overcome this. B must make a decision, B must choose between:

ABOVE: B gives 4 points away, and A loses nothing.
BELOW: B gives no points away, and A loses 27 points.

If the computer draws a number larger than 6, B loses all his or her points for this period. A can overcome this. A must make a decision, A must choose between:

ABOVE: A gives 4 points away, and B loses nothing.
BELOW: A gives no points away, and B loses 27 points.

The relevant numbers will be highlighted in red on the screen. These are the numbers that you need to copy in the right form under part 1, part 2, or part 3 of this instruction paper. After you have pressed the ‘continue’ button, to signal that you are done, you will no longer be able to see the conditions on the screen. The conditions can still be found on your form.

The procedure of one period is shown in detail below. Firstly, the computer chooses a number between 1 and 4. If 4 has been chosen, all persons will be re-matched by random, and the roles (A or B) will be newly assigned. If a number smaller than 4 has been chosen each person stays matched with the same person, and keeps the same role. Persons are matched and assigned roles for the first time in the first period.

The computer furthermore determines who is asked to make a decision. If you are required to make a decision, you will see the following message on your screen:

The computer draws number 7. B is threatened to lose his or her points. You are A. You must choose between: ABOVE: A gives 4 points away, and B loses nothing. BELOW: A gives no points away, and B loses 27 points.

In this example, you play the role of A and you must choose between ABOVE and BELOW. If A chooses ABOVE, A loses 4 points, and B loses nothing. If A chose BELOW, A loses nothing, and B loses 27 points.

If you are not asked to make a decision in this period, you will see the following message on your screen:

The computer draws number 2. You are threatened to lose your points and B must choose. You now have to wait until B has made his or her decision.

After the other person has made a decision, the decision will be shown. Which decisions have been made so far can be seen at the bottom of the screen at all times. Furthermore the points that you or the other person have received so far, remain visible at the bottom of the screen. As long as you are matched with the same person, the computer keeps track of the number of periods. If you are re-matched with a new person, the computer restarts the count.

Part 1

The experiment starts here!

Please copy the information from the screen onto the form below. Afterwards please press the 'continue' button to signal that you are done.

Each person receives 20 points at the beginning of each period.
The computer draws a number between 1 and _____.
If the computer draws a number smaller or equal to ____, person B is threatened to lose his or her points and person A must make a decision.
Person A must therefore make a decision with a probability of ____.

If A is required to make a decision, A must choose between:

ABOVE: A loses ____ points, and B loses nothing.
BELOW: A loses nothing, and B loses ____ points.

If the computer draws a number smaller or equal to ____, person A is threatened to lose his or her points and person B must make a decision.
Person B is therefore required to make a decision with a probability of ____.

If B is required to make a decision, B must choose between:

ABOVE: B loses ____ points, and A loses nothing.
BELOW: B loses nothing, and A loses ____ points.

At the end of part 1, the choice situation will change. Please fill the new numbers that you see on the screen onto the form part 2 on the next page.

Note: Parts 2 and 3 and the practice part are analogous to part 1. We do not report on the questionnaire regarding demographics, gender, etc here, since we did not use them in the related chapters.

Appendix C

Instructions for the Experiments of Chapters 4 and 5

This appendix provides the English translation of the Dutch instructions for the experiment of Chapters 4 and 5.

Introduction

Welcome to this experiment. In this experiment, you have the possibility to earn money depending on the choices you make. Your earnings will be paid to you at the end of the experiment, privately and in cash. During the experiment you will earn points that will later be exchanged into money at the rate of 1 point = 1 eurocent. In this experiment, you are asked to make many decisions and you can earn a lot of points. Therefore, read the following instructions carefully and make your choice carefully.

These instructions contain all the information you need to complete the experiment. Therefore, you are kindly requested to remain quiet and not to ask any question, unless absolutely necessary. From this moment on, you should not speak with anybody in this room and you should not look at the monitors of your fellow participants. It is important for us that your decisions are completely independent and based only on the information that you received from these instructions and on what you see on the screen of your computer. There are no 'right' or 'wrong' choices.

The experiment consists of four parts. Part 1 is a questionnaire. This questionnaire is not part of the payment that you receive, because the questions are only about hypothetical choice situations.

You will receive 1000 points worth 10 Euros (each 100 points are 1 Euro) in the beginning of part 2. In part 2 and part 3 you can *win* more points – but you can also *lose* points. At the end of the experiment, the money will be paid, in cash and in private, so that participants do not see how much others have earned. Part 4 is a short questionnaire.

You can now start with the experiment. Press the 'continue' button and start with part 1 of the experiment.

Appendix C

Part 1

Choice situation 1

Imagine a box with 20 'lucky' white balls and 20 'unlucky' black balls. You can draw a ball out of the box without looking into it, so you have an equal chance of drawing a 'lucky' white or an 'unlucky' black ball.

> If you draw a 'lucky' **white** ball, then you <u>win</u> ***100 Euros***.
> If you draw an 'unlucky' **black** ball, then you <u>win</u> ***0 Euro***.

We ask you to choose between drawing a ball from the box described above or **wining** a sure amount of money.

We will now specify the amounts of money you can win.

Please indicate whether you want to draw a ball, or whether you would rather win the sure amount of money.

	Draw a ball	**Sure amount**
Would you rather draw a ball, or win ***70 Euro*** for sure?	☐	☐
Would you rather draw a ball, or win ***60 Euro*** for sure?	☐	☐
Would you rather draw a ball, or win ***55 Euro*** for sure?	☐	☐
Would you rather draw a ball, or win ***50 Euro*** for sure?	☐	☐
Would you rather draw a ball, or win ***45 Euro*** for sure?	☐	☐
Would you rather draw a ball, or win ***40 Euro*** for sure?	☐	☐
Would you rather draw a ball, or win ***30 Euro*** for sure?	☐	☐

Note: We only report choice situation 1, since Choice situations 2 to 5 are analogous.

Part 2: You and your partner can lose points

You are matched together with another participant for a certain number of periods. The computer determines at random whom you are matched with. Each person is given a specific role. We call these roles role A and role B. The computer also determines at random what role a person is given.

In every period you or the person whom you are matched with can *lose* points. The computer determines who can lose points. The computer draws a number between 1 and 10:

If the computer draws a number smaller or equal to 7, A is threatened to lose points. This happens with a chance of $\frac{7}{10}$. B can overcome this threat. B must choose between:

> ABOVE: B gives 8 points away. A loses nothing.
> BELOW: B gives no points away. A loses 24 points.

If the computer chooses a number larger than 7, B is threatened to lose points. This happens with a chance of $\frac{3}{10}$. A can overcome this threat. A must choose between:

> ABOVE: A gives 8 points away. B loses nothing.
> BELOW: A gives no points away. B loses 24 points.

Information about the results of each period is displayed at the bottom of your screen.

Everybody will now be matched with another participant and will receive a role. The computer will tell you what role you have. After **five** periods you will be matched with a new person. Sometimes you have role A and the participant you are matched with has role B, and sometimes it is the other way around. The computer will always make clear when you are matched with a new person and what role you have. During and after the experiment you will not know who the other participants were that you were matched with. After **six times five** periods this part ends and you can continue with part 3 on page 4.

Press the 'continue' button to start with part 2 of the experiment.

Part 3: You and your partner can win points

In every period you or the person whom you are matched with can *win* points. Which of you wins points will be determined by the computer. The computer draws a number between 1 and 10:

If the computer draws a number smaller or equal to 7, A has the opportunity to win points. This happens with a chance of $\frac{7}{10}$. B can seize this opportunity for A. B must choose between:

ABOVE: B gives 8 points away. A wins 24 points.
BELOW: B gives no points away. A wins nothing.

If the computer chooses a number larger than 7, B has the opportunity to win points. This happens with a chance of $\frac{7}{10}$. A can seize this opportunity for B. A must choose between:

ABOVE: A gives 8 points away. B wins 24 points.
BELOW: A gives no points away. B wins nothing.

Information about the results of each period can be seen at the bottom of your screen.

Like in part 2, you remain matched with another participant six times five periods. After each fifths period you will be matched with a new participants and be reassigned to role A or B.

Press the ’continue’ button to start with part 3 of the experiment.

Note: We do not report the questionnaire regarding demographics, gender etc here, since we did not use them in the related chapters.

Appendix D

Details on the One-Shot Kalai-Smorodinsky Bargaining Solution of Chapter 5

To derive the target support ratio based on Kalai-Smorodinsky bargaining theory (KS-solution), we study the Support Game as a continuous game in which *i* decides on the extent $\alpha_i \in [0,1]$ to which he or she provides support to the other actor. The KS-solution is defined as the Pareto-optimal vector (α_A^*, α_B^*) of support decisions, so that both players receive the same proportion of their maximum utility relative to the status quo payoff of no support (0, 0). The (normalized) linear utility function V_i can be written as

$$V_i(\alpha) = \kappa_i \alpha_j - \alpha_i \text{, with } \kappa_i = \frac{b_i \pi_i}{c_i \pi_j}.$$

Let $\kappa_A > \kappa_B$. The strategy vector (0, 0) is Pareto-inefficient if

$$\kappa_B^{-1} \leq \frac{\alpha_A}{\alpha_B} \leq \kappa_A .$$

The most attractive outcome from *i*'s perspective is that *j* always provides support, $\alpha_j = 1$, while *i* himself provides just enough support to make *j* indifferent with the situation in which *i* provides no support at all. This, however, need not be feasible. If actor *j* provides full support, actor *i* need not necessarily have to be able to compensate him. In this case α_i would need to be larger than 1. If this is the case, it is best from *i*'s perspective if *i* provides full support, $\alpha_i = 1$, while *j* provides the maximal amount of support he is willing to give in return. In both cases player *i*'s maximal individually payoff is attained if the support ratio $\frac{\alpha_i}{\alpha_j}$ is minimally subject to the conditions (D.1). Denote by $\alpha_i^{(i)}$ is the behavior of *i* that is optimal for *j*, and by $\alpha_j^{(i)}$ the behavior of *j* that is optimal for *i*. Then

$$\alpha_j^{(i)} = \min(1, \kappa_j) \text{ and } \alpha_i^{(i)} = \min(1, \tfrac{1}{\kappa_j}).$$

Consequently,

$$\tilde{V}_i = \kappa_i \alpha_j^{(i)} - \alpha_i^{(i)} = \kappa_i \min(1, \kappa_j) - \min(1, \kappa_j^{-1}),$$

which simplifies to $\frac{\kappa_A}{\kappa_B}$ if $\kappa_A, \kappa_B > 1$, to κ_A if $\kappa_A > 1 > \kappa_B$.

(The case $\kappa_A, \kappa_B < 1$ is inconsistent with $b_i > c_i$).

The KS-solution can be rewritten such that

$$\text{if } \kappa_A,\ \kappa_B > 1: \frac{V_A(\alpha)}{V_B(\alpha)} = \frac{\kappa_A\alpha_B - \alpha_A}{\kappa_B\alpha_A - \alpha_B} = \frac{\kappa_A}{\kappa_B} \Leftrightarrow k_{AB} = \frac{\alpha_A}{a_B} = \frac{\kappa_A(1+\kappa_B)}{\kappa_B(1+\kappa_A)},$$

$$\text{if } \kappa_A > 1 > \kappa_B\ : \frac{V_A(\alpha)}{V_B(\alpha)} = \frac{\kappa_A\alpha_B - \alpha_A}{\kappa_B\alpha_A - \alpha_B} = \kappa_A \Leftrightarrow \frac{\alpha_A}{a_B} = \frac{2\kappa_A}{1+\kappa_A\kappa_B}.$$

For simplicity in the presentation, we focused on the *one-shot* Kalai-Smorodinsky bargaining solution, rather than on the KS-solution of the repeated game $\bar{\kappa}$. Weesie (2005) applies the Kalai-Smorodinsky bargaining solution to the set of outcomes supported by a subgame perfect equilibrium in trigger strategies. If $\theta_i w$ and $\theta_j w \to \infty$, then $\bar{\kappa}_{AB} \to \kappa_{AB}$, where θ_i is actor *i*'s discount parameter and *w* the continuation probability. Since we use a continuation probability $w = 0.8$ in the experimental tests (see section 4) and discount parameters should be close to 1, there are no substantial differences in the results between the one-shot and the repeated solutions. Weesie (2005) also studied Nash bargaining theory (Nash 1950). Since the predictions from these two bargaining theories are 'highly correlated', we do not give details here.

Samenvatting (Summary in Dutch)

In dit boek bestuderen we hoe de mate van wederzijdse hulp afhangt van *heterogeniteit* in individuele eigenschappen tussen personen. De individuele eigenschappen waarin personen kunnen verschillen in deze studie zijn de *kosten van het geven van hulp, de opbrengsten van het krijgen van hulp* en de *kans om in de toekomst hulp nodig te hebben.* Sociale hulp vindt plaats in uiteenlopende situaties. Voorbeelden zijn collega's die elkaar helpen op het werk, vrouwen die voor elkaars kinderen zorgen of studenten die boeken aan elkaar lenen (Blau 1964). In de introductie bespreken we het voorbeeld van twee buurvrouwen, mevrouw Morgenstern en mevrouw Neumann. Beide vrouwen werken parttime en kunnen elkaar van tijd tot tijd helpen door op elkaars kind te passen als de ander werkt. Beide vrouwen werken als verpleegster op oproepbasis in het ziekenhuis. De bonussen die de twee vrouwen ontvangen zijn verschillend. Mevrouw Morgenstern krijgt een hogere bonus als ze gaat werken omdat ze op een intensive care afdeling werkt. Mevrouw Morgenstern heeft dus hogere opbrengsten van het krijgen van hulp. Daarnaast is mevrouw Morgensterns kind ouder dan mevrouw Neumanns kind. Dit heeft als gevolg dat het mevrouw Neumann meer kost om hulp te geven. Tot slot verschillen mevrouw Neumann en mevrouw Morgenstern ook in de kans waarmee ze worden opgeroepen door het ziekenhuis en dus in de kans waarmee ze hulp nodig hebben. We hebben dus situaties waarbij bijvoorbeeld mevrouw Morgenstern op een dag hulp nodig heeft en mevrouw Neumann die hulp kan geven. Dit levert mevrouw Morgenstern iets op en brengt kosten met zich mee voor mevrouw Neumann. In de toekomst zullen de rollen omgekeerd zijn. We gaan er vanuit dat de opbrengsten van het ontvangen van hulp voor één persoon hoger zijn dan zijn of haar kosten van het geven van hulp aan de ander.

Deze studie volgt rationele keuzetheorie en ruiltheorie waarbij ervan wordt uitgegaan dat het geven van hulp het resultaat is van doelgericht gedrag (Homans 1961, Blau 1964, Becker 1981, Coleman 1988, Cook en Levi 1990, Molm 1990, Voss 2001, Raub en Buskens 2006). We veronderstellen dat de keuze van iemand om hulp te geven afhankelijk is van de eigenschappen van de persoon zelf en van de eigenschappen van de persoon die hulp vraagt. Deze eigenschappen zijn de kosten van het geven van hulp, de opbrengsten van het ontvangen van hulp en de kans om in de toekomst hulp nodig te hebben. Sociale hulp wordt in deze studie alleen geanalyseerd op het *niveau van dyades*. Dit betekent dat we niet kijken naar derde personen die eventueel een rol zouden kunnen spelen bij iemands keuze om hulp al dan niet te geven. Meer specifiek analyseren we of het niveau van wederzijdse hulp hoger is wanneer personen hetzelfde ofwel 'homogeen' zijn, in tegenstelling tot wanneer personen verschillend of 'heterogeen' zijn. Bij welke *combinaties* van homogeniteit en heterogeniteit in de genoemde individuele eigenschappen is wederzijdse hulp het meest waarschijnlijk? Tevens bestuderen we de effecten van verschillen in de *mate* van heterogeniteit in individuele eigenschappen op hulp. Dit leidt tot de volgende onderzoeksvragen:

1. *Is wederzijdse hulp waarschijnlijker wanneer personen homogeen of wanneer personen heterogeen zijn met betrekking tot één of meerdere individuele eigenschappen?*
2. *Is wederzijdse hulp waarschijnlijker wanneer personen heterogeen zijn met betrekking tot één individuele eigenschap, of wanneer ze heterogeen zijn met betrekking tot verscheidene individuele eigenschappen? Hangt het effect van heterogeniteit in één eigenschap af van heterogeniteit in een andere eigenschap, en zo ja, op welke manier?*
3. *Leidt een toename van heterogeniteit in één of meerdere individuele eigenschappen tussen personen tot meer of minder wederzijdse hulp?*

Een belangrijk punt bij het bestuderen van heterogeniteit is op welke manier homogeniteit en heterogeniteit het best *vergeleken* kunnen worden. Wanneer homogene personen bijvoorbeeld gemiddeld hogere opbrengsten hebben van hulp dan heterogene personen, wordt de vergelijking tussen homogeniteit en heterogeniteit ambigue. Het effect van heterogeniteit en het effect van hogere opbrengsten lopen dan immers door elkaar. We kunnen de situatie waarin mevrouw Neumann en mevrouw Morgenstern allebei een bonus van 150 euro per week krijgen vergelijken met een situatie waarin mevrouw Morgenstern een bonus heeft van 125 en mevrouw Morgenstern een bonus krijgt van 175 euro. Met betrekking tot het effect van heterogeniteit is het minder interessant om de homogene situatie waarin beiden een bonus van 150 euro krijgen te vergelijken met een situatie waarin mevrouw Morgenstern een bonus krijgt van 150 euro per week en mevrouw Neumann een bonus krijgt van 175 euro per week. Wanneer het niveau van hulp hoger is in de laatstgenoemde situatie dan weten we niet of dit toe te schrijven is aan toegenomen heterogeniteit tussen de vrouwen of aan het feit dat het totaal aan opbrengsten is toegenomen van 300 naar 325 euro.

Het merendeel van de literatuur over de rol van homogeniteit bij sociale hulp en over ‘asymmetrische sociale dilemma’s’, maakt geen zorgvuldig onderscheid tussen de effecten van heterogeniteit in de ‘prikkels’ van personen en een algemene stijging of daling van de prikkels die personen hebben om wederzijds hulp te geven (Schellenberg 1964, Sheposh and Gallo 1973, Murninghan en King 1992). Daarom verschaffen deze studies een op zijn hoogst ambigue antwoord op de onderzoeksvragen die hierboven zijn gesteld. Tevens richt de literatuur zich meestal slechts op heterogeniteit in één eigenschap of op additieve effecten van meerdere vormen van heterogeniteit. Gebaseerd op onze speltheoretische analyse bestuderen we hiernaast ook of er *interactie-effecten* optreden tussen heterogeniteit in *meerdere* eigenschappen en of zulke interacties een positief of negatief effect hebben op sociale hulp. In hoofdstuk 2 laten we zien dat er sprake is van niet onbelangrijke interactie-effecten zijn en dat deze interacties zowel positief als negatief kunnen zijn.

We gebruiken speltheorie om het effect van heterogeniteit op sociale hulp te bestuderen. We analyseren in het bijzonder één spel, het zogenaamde ‘herhaalde helpspel’. We leiden voor dit spel een theoretisch evenwicht af en gebruiken differentiaalrekening om de optimale condities voor wederzijdse hulp te voorspellen. We kijken dus bij welke verdeling van individuele eigenschappen tussen personen we verwachten dat het niveau van wederzijdse hulp maximaal is. Het herhaalde helpspel wordt ook gebruikt als een model voor de experimentele toetsen in deze studie. We vatten in de volgende paragrafen het theoretische en empirische onderzoek van hoofdstuk 2 tot en met 5 samen. Ten slotte resumeren we de thesis.

In hoofdstuk 2 analyseren we het herhaalde helpspel. Het herhaalde helpspel is een variant op het herhaalde gevangenendilemma. Het ontvangen van hulp is voordelig, en het geven van hulp brengt kosten met zich mee. Elke persoon geeft liever geen hulp, maar wil zelf wel graag hulp ontvangen. Na elke hulpvraag en de beslissing van de ander om al dan niet hulp te geven is er een kans dat het spel verder gaat en er weer iemand hulp nodig heeft. Wederzijdse hulp is (Pareto-)efficiënt als de verwachte opbrengsten voor de personen van het ontvangen van hulp, hoger zijn dan de verwachte kosten voor het geven van hulp. We leiden de evenwichtsconditie voor wederzijdse hulp af in het herhaalde helpspel gebaseerd op zogenaamde 'triggerstrategieën'. Een persoon die een triggerstrategie gebruikt is nooit de eerste om hulp te weigeren, maar nadat de andere persoon ook maar één keer hulp weigert, vergeeft de persoon met de triggerstrategie dit nooit en blijft hulp daarna weigeren. Volgens de evenwichtsconditie is het voor *beide* personen individueel rationeel om hulp te geven, mits de kans dat het helpspel verder gaat 'groot genoeg' is. Wat groot genoeg is, hangt af van de individuele eigenschappen van beide personen, zoals de kosten van het geven van hulp, de opbrengsten van het ontvangen van hulp en de kans om in de toekomst hulp nodig te hebben. Omdat de evenwichtsconditie impliceert dat de kans dat het helpspel verder gaat voor beide personen *tegelijk* groot genoeg moet zijn, kan het niet zo zijn dat de kans groot genoeg is voor de een en niet voor de ander. Om deze reden zullen in evenwicht beide partners altijd hulp geven of beide partners nooit hulp geven. Bij het bestuderen van heterogene personen veronderstelt onze analyse dat personen dezelfde strategieën in evenwicht gebruiken. Dit punt bespreken we opnieuw in hoofdstuk 5. We analyseren de evenwichtsconditie om na te gaan of sociale hulp waarschijnlijker is onder homogeniteit of heterogeniteit. Omdat we geïnteresseerd zijn in sociale hulp op het niveau van dyades, is deze analyse relatief complex. We leiden meerdere hypothesen af.

Ten eerste, als er homogeniteit is op twee van de drie individuele eigenschappen, dan leidt homogeniteit op de derde individuele eigenschap tot de optimale conditie voor sociale hulp. Als mevrouw Morgenstern en mevrouw Neumann bijvoorbeeld homogeen zijn wat betreft de opbrengsten van het ontvangen van hulp en de kans om hulp nodig te hebben, dan is sociale hulp het meest waarschijnlijk als ze ook homogeen zijn met betrekking tot de kosten van het geven van hulp. Sociale hulp is dus waarschijnlijker in een situatie van complete homogeniteit in individuele eigenschappen dan wanneer er heterogeniteit is in één van die eigenschappen – dit is een gebruikelijke bevinding in studies naar de rol van homgeniteit bij sociale hulp (zie hoofdstuk 1).

Ten tweede blijkt dat als we heterogeniteit in een tweede eigenschap toevoegen aan een situatie waarin personen al in één eigenschap verschillen, dit niet altijd leidt tot minder hulp. Heterogeniteit in twee individuele eigenschappen kan een positief interactie-effect vertonen (compensatie) of een negatief interactie-effect (accumulatie). Als er heterogeniteit is in twee individuele eigenschappen dan kan de heterogeniteit in de ene eigenschap het negatieve effect van heterogeniteit in de andere eigenschap niet alleen versterken, maar ook afzwakken. Dit komt doordat heterogeniteit in een bepaalde eigenschap ertoe leidt dat één van de personen in een zwakkere positie komt. Als heterogeniteit in de andere eigenschap nu de positie van de andere persoon verslechtert, treedt er compensatie op. Een voorbeeld hiervan is de situatie waarin mevrouw Neumann het probleem heeft van hoge kosten voor hulp, terwijl mevrouw Morgenstern het probleem heeft van lage opbrengsten van hulp. Accumulatie van heterogeniteit treedt op als één persoon twee problemen heeft. Bijvoorbeeld mevrouw Neumann heeft zowel hoge kosten voor het geven van hulp als lage opbrengsten van het krijgen van hulp. We verwachten dus meer hulp onder optimale compensatie in twee of meer eigenschappen dan onder heterogeniteit in één eigenschap. Als er twee soorten heterogeniteit accumuleren, is hulp waarschijnlijker onder heterogeniteit in één eigenschap dan onder geaccumuleerde heterogeniteit.

Ten derde is sociale hulp het meest waarschijnlijk wanneer personen volledig homogeen zijn. De optimale situatie voor wederzijdse hulp doet zich dus voor wanneer beide vrouwen homogeen zijn met betrekking tot de kosten van het geven van hulp, de opbrengsten van het ontvangen van hulp en de kans om in de toekomst hulp nodig te hebben. Dus in het geval van mevrouw Neumann en mevrouw Morgenstern: de kinderen zijn van dezelfde leeftijd, de vrouwen ontvangen dezelfde bonus en beiden worden even vaak opgeroepen door het ziekenhuis. Zelfs in het geval van compensatie van heterogeniteit in meerdere eigenschappen kan het verwachte niveau van hulp in de volledig homogene situatie niet gehaald worden.

Tot slot verschilt het effect van een verhoging in de *mate* van heterogeniteit op sociale hulp tussen de situatie van heterogeniteit in één en heterogeniteit in meerdere eigenschappen. Als er meer heterogeniteit komt in één individuele eigenschap, wordt wederzijdse hulp minder waarschijnlijk. Hetzelfde geldt voor accumulerende heterogeniteit in twee individuele eigenschappen. In een situatie van compenserende heterogeniteit in twee individuele eigenschappen, kan toegenomen heterogeniteit echter ook wederzijdse hulp mogelijk maken – zolang de twee heterogene individuele eigenschappen elkaar nog niet optimaal compenseren. Wanneer ze elkaar optimaal compenseren belemmert toegenomen heterogeniteit, net als in de bovenstaande situaties, wederom wederzijdse hulp.

We zien dat de interactie-effecten van heterogeniteit in twee eigenschappen niet onbelangrijk zijn. Het merendeel van de literatuur over homogeniteit en sociale hulp veronderstelt, impliciet of expliciet, dat wanneer personen heterogener zijn er ook minder sociale hulp zal zijn. Dit veronachtzaamt echter de mogelijkheid van compenserende heterogeniteit in twee individuele eigenschappen. Heterogeniteit toevoegen of vergroten maakt wederzijdse hulp niet per definitie moeilijker. Uitgaande van heterogeniteit op één individueel kenmerk, kan het toevoegen van heterogeniteit op een ander individueel kenmerk sociale hulp zelfs faciliteren, gegeven dat de additionele heterogeniteit zich op de juiste manier verhoudt tot de oorspronkelijke heterogeniteit. Om deze reden stellen we dat het niet volstaat om de gevolgen van heterogeniteit in verschillende variabelen te bestuderen door te kijken naar de som van de effecten van meerdere vormen van heterogeniteit. Het is belangrijk om interactie-effecten tussen verschillende vormen van heterogeniteit in de analyse te betrekken.

Hoofdstuk 3 bespreekt experimenteel onderzoek van de speltheoretische voorspellingen van hoofdstuk 2. In een laboratoriumexperiment spelen proefpersonen verscheidene herhaalde helpspelen. Heterogeniteit wordt gevarieerd via de kosten van het geven van hulp en de kans om hulp nodig te hebben. Om de hypothesen te toetsen is het voldoende om heterogeniteit in deze twee eigenschappen te beschouwen. In de experimentele opzet krijgen proefpersonen voor elke keer dat iemand hulp nodig heeft een bepaald bedrag. Dan dreigt de helft van de proefpersonen dit bedrag weer te verliezen. Dit zijn dus degenen die hulp nodig hebben. De andere helft van de proefpersonen kan dit voorkomen door een deel van hun eigen bedrag op te geven. Net als in het theoretische model wordt deze interactie met een bepaalde kans herhaald, terwijl de proefpersonen aan dezelfde partner gekoppeld blijven. De toetsen van de hypothesen laten zoals voorspeld zien dat wanneer de evenwichtsconditie restrictiever is, sociale hulp minder waarschijnlijk is. Het model dat – in de statistische zin – verzadigd is met betrekking tot de experimentele condities past aanzienlijk beter bij de data dan het model dat op de evenwichtsconditie gebaseerd is. Om die reden houden we een slag om de arm bij de conclusie dat de effecten van heterogeniteit op wederzijdse hulp verklaard worden door de evenwichtsconditie van het herhaalde helpspel. Een paarsgewijze vergelijking van de experimentele condities toont aan dat wederzijdse hulp tussen homogene personen significant verschilt van wederzijdse hulp tussen heterogene personen. Ook is het zo dat hoe heterogener personen zijn met betrekking tot individuele eigenschappen, des te minder waarschijnlijk sociale hulp is. Tevens neemt wederzijdse hulp af als heterogeniteit in de kosten en in de kans om hulp nodig te hebben accumuleren. Tot slot verwachten we dat hoe groter de compensatie tussen heterogeniteit in de kosten om hulp te geven en in de kans om hulp nodig te hebben is, des te waarschijnlijker wederzijdse sociale hulp is. Deze voorspelling wordt niet ondersteund door de data. Deze toets is echter niet dwingend door een beperkte steekproefomvang. Helaas staat het experimentele ontwerp ons niet toe om compenserende heterogeniteit zinvol te vergelijken met heterogeniteit op één eigenschap of met accumulerende heterogeniteit. Het zou interessant zijn om te zien of compenserende heterogeniteit werkelijk tot meer hulpvaardig gedrag leidt dan accumulerende heterogeniteit. Desondanks kunnen we concluderen dat heterogeniteit en accumulerende heterogeniteit een negatief effect hebben op wederzijdse hulp. Om er zeker van de zijn dat we enkel het effect van heterogeniteit op het niveau van hulp meten hebben we de som van de kosten en de kans om hulp nodig te hebben constant gehouden. Om deze reden kunnen we uitsluiten dat van het negatieve effect van heterogeniteit op wederzijdse hulp wordt veroorzaakt door een toename in de som van de kosten of een toename in de kans om hulp nodig te hebben.

In hoofdstuk 4 maken we onderscheid tussen twee soorten van sociale hulp situaties. Sociale hulp kan als doel hebben om iemand te beschermen tegen het 'lijden van verlies', zoals in het experiment van hoofdstuk 3. Mevrouw Neumann kan op het kind van mevrouw Morgenstern letten, zodat mevrouw Morgenstern naar de bank kan gaan om via onderhandeling een dreigende verhoging van de rentevoet van haar hypotheek tegen te gaan. Het geven van hulp kan ook de vorm aannemen van het mogelijk maken dat iemand een 'winst kan maken' of een voordeel kan uitbuiten. In dit geval kan mevrouw Neumann op het kind van mevrouw Morgenstern letten zodat mevrouw Morgenstern kan genieten van het middagje in een kuuroord dat ze heeft gewonnen in een loterij. Dit leidt tot de interessante vraag of wederzijdse hulp verschilt tussen winst- en verliessituaties. Onder de assumptie van risiconeutraliteit worden er geen verschillen verwacht tussen deze twee soorten situaties. Als personen echter risicoaversief of risicozoekend zijn, ondergaan zij winst- en verliessituaties verschillend.

Risicoaversieve proefpersonen proberen risico te vermijden. Deze proefpersonen worden in sterke mate beïnvloed door de slechtste uitkomst van de winst- en verliessituaties bij de keuze om al dan niet hulp te geven. Dit is de situatie waarin ze verlies kunnen lijden en geen hulp krijgen. De situatie is tegengesteld voor proefpersonen die risicozoekend zijn. Deze proefpersonen aarzelen niet om risico te nemen. Als gevolg hiervan worden ze in sterke mate gemotiveerd door de beste uitkomst van de winst- en verliessituaties. Ze zullen als ze een kans hebben op extra winst die kans eerder willen aangrijpen. Om deze reden verwachten we dat risicoaversieve proefpersonen meer helpen in verlies- dan in winstsituaties, terwijl risicozoekende proefpersonen meer helpen in winst- dan in verliessituaties. In welke situatie wederzijdse hulp groter is, ofwel in winstsituaties, ofwel in verliessituaties, hangt dus af van de risicopreferenties van de proefpersonen. Hiermee komen we terug bij onze hoofdvraag en onderzoeken of de effecten van heterogeniteit (in de kans om hulp nodig te hebben) hetzelfde zijn onder winst- en verliessituaties. In lijn met de hypothesen uit de vorige hoofdstukken verwachten we dat proefpersonen minder hulpvaardig zijn onder heterogeniteit dan onder homogeniteit in de kans om hulp nodig te hebben. We verwachten dat dit effect groter is naarmate er meer proefpersonen risicozoekend zijn en kleiner naarmate er meer proefpersonen risicoaversief zijn.

De hypothesen worden getoetst door middel van een experiment. Eerst meten we de risicopreferenties van de proefpersonen en vervolgens laten we de proefpersonen het herhaalde helpspel spelen. Er treden zowel winst- als verliessituaties op. Geen van onze hypothesen over het effect van risicopreferenties op wederzijdse hulp in winst- en verliessituaties wordt door de data ondersteund. Alleen de hypothese over de effecten van heterogeniteit wordt deels ondersteund. De belangrijkste reden voor deze teleurstellende resultaten is een gebrek aan statistische 'power'. Ten eerste is er weinig variatie in de risicopreferenties van de proefpersonen en zijn er veel proefpersonen die ongeveer risiconeutraal zijn. Ten tweede is het percentage proefpersonen dat hulp geeft in de eerste ronde zeer hoog, namelijk 84%. Aangezien er weinig variatie is in risicopreferenties en er een hoge mate van hulp is in de eerste ronde in winst- en verliessituaties, is de toetsing van onze hypothesen vrij zwak.

In hoofdstuk 5 ontwikkelen we een nieuwe theorie om de empirische bevindingen van de eerdere hoofdstukken te verklaren. De experimenten in hoofdstuk 3 en 4 laten zien dat heterogene personen elkaar minder vaak hulp verlenen dan verondersteld wordt in de evenwichtsanalyse van het herhaalde helpspel in hoofdstuk 2. Bovendien vinden we dat heterogene personen verschillen in de mate waarin ze hulp geven. Dit lijkt intuïtief redelijk, maar komt niet terug in onze theorie van hoofdstuk 2. Daarom proberen we de theorie uit hoofdstuk 2 te verbeteren en we breiden deze uit met een benadering gebaseerd op ‘empirische speltheorie’. Dit hoofdstuk bestudeert de gedragsdynamica van sociale hulp tussen heterogene personen. We richten ons voornamelijk op welke personen vaker hulp geven in duurzame relaties en hoe het geven van hulp afhangt van wat er in het verleden is gebeurd. Waarom zouden twee personen elkaar even vaak helpen wanneer bijvoorbeeld voor de één de kosten twee keer zo hoog zijn als voor de ander? Het is waarschijnlijk dat heterogeniteit in kosten ervoor zorgt dat de persoon waarvoor hulp geven minder duur is vaker hulp geeft dan de ander. Als mevrouw Morgenstern twee keer zo vaak hulp nodig heeft van mevrouw Neumann dan andersom, lijkt het redelijk dat mevrouw Morgenstern elke keer op het kind van mevrouw Neumann past als mevrouw Neumann hulp nodig heeft, terwijl mevrouw Neumann bijvoorbeeld maar de helft van de keren op het kind van mevrouw Morgenstern past. Mevrouw Morgenstern zou een professionele babysitter kunnen inhuren voor de overige keren dat ze hulp nodig heeft. In onze analyse veronderstellen we dat, afhankelijk van de eigen eigenschappen en die van de ander, personen een (normatief) ‘idee’ hebben over hoe vaak ze hulp zouden moeten geven en hoe vaak anderen hulp zouden moeten geven. We definiëren zo’n ‘idee’ van een persoon als een ratio van de voorwaardelijke kansen om hulp te leveren van beide personen, de zogenoemde *gewenste hulpratio*. Personen vergelijken hun ervaringen met de partner in het verleden, in de vorm van de *ervaren hulpratio* met de gewenste hulpratio. Veronderstellend dat personen proberen om de gewenste hulpratio en de ervaren hulpratio op elkaar af te stemmen, kunnen we voorspellingen maken over het gedrag van personen. De kans dat personen hulp geven is groter naarmate hulp geven leidt tot betere overeenstemming tussen de ervaren hulpratio en de gewenste hulpratio.

Eén doel van dit hoofdstuk is om gewenste hulpratio’s af te leiden vanuit verschillende theoretische benaderingen. Idealiter nemen dergelijke gewenste hulpratio’s de heterogeniteit tussen personen in overweging in zowel de kosten van het geven van hulp als de opbrengsten van het ontvangen van hulp en de kans om in de toekomst hulp nodig te hebben. We leiden gewenste hulpratio’s af uit twee soorten assumpties. Ten eerste uit sociaalpsychologische assumpties zoals gebruikt in equity-theorie (‘equity theory’) en ten tweede uit speltheoretische assumpties, zoals gebruikt in onderhandelingstheorie (‘bargaining theory’). Volgens de hulpratio afgeleid vanuit equity-theorie, zullen beide personen hulp geven in die mate dat hun kosten en opbrengsten in gelijke verhouding staan tot elkaar. De voorspellingen gebaseerd op onderhandelingstheorie zijn minder intuïtief. Volgens de hulpratio afgeleid uit onderhandelingstheorie worden de opbrengsten van hulp verdeeld relatief aan het nut van de best mogelijke uitkomst. De voorspellingen van beide theorieën stemmen volledig overeen in welke personen vaker hulp geven, maar equity-theorie voorspelt grotere verschillen. De voorspellingen zijn getoetst met de twee experimenten beschreven in hoofdstuk 3 en 4. Beide datasets bevestigen de voorspellingen van equity- en onderhandelingstheorie over zowel wie aanvankelijk de meeste hulp geeft, als over de dynamiek ervan. Interessant genoeg vinden we dat de persoon die de meeste hulp moet geven volgens de gewenste hulpratio sterker beïnvloed wordt door de mate van overeenstemming tussen de gewenste en ervaren hulpratio dan zijn of haar partner. Dit geldt voor zowel equity- als onderhandelingstheorie. De voorspellingen van onderhandelingstheorie passen iets beter bij de data dan die van equity-theorie. Omdat equity-theorie altijd meer extreme gewenste hulpratio’s voorspelt dan onderhandelingstheorie, concluderen we voorzichtig dat proefpersonen niet streven naar ‘te extreme’ hulpratio’s, waar ‘extreem’ betekent dat één persoon veel vaker hulp geeft dan de andere persoon.

Samenvattend leidt dit boek hypothesen af over de manier waarop heterogeniteit tussen personen het niveau van wederzijdse hulp beïnvloed. Sociale hulp wordt beschouwd als doelgericht gedrag. We bestuderen heterogeniteit in individuele eigenschappen zoals de kosten van het geven van hulp, de opbrengsten van het ontvangen van hulp en de kans om hulp nodig te hebben. Theoretisch en empirisch onderzoek laat zien dat heterogeniteit in één van deze individuele eigenschappen tussen personen sociale hulp belemmert. Heterogeniteit in meerdere individuele eigenschappen kan echter interactie-effecten vertonen zodanig dat heterogeniteit tussen twee personen sociale hulp zowel kan beperken als faciliteren. Tevens laat dit boek zien dat heterogene personen niet even vaak hulp geven. Heterogeniteit in individuele eigenschappen beïnvloedt welke persoon vaker hulp verleent.

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Curriculum Vitae

Sonja Vogt was born in Marsberg, Germany, in 1976. From 1996 to 2001, she studied Sociology, Philosophy, and Linguistics at Düsseldorf University, Germany, where she obtained a Master's degree cum laude. From December 2001 until August 2002, she worked as a research assistant at the Department of Philosophy at Bayreuth University, Germany. In September 2002 she became a Ph.D. student at the Interuniversity Center for Social Theory and Methodology (ICS) at the Department of Sociology at Utrecht University, Netherlands. In 2004, she participated in the ICPSR Summer Program in Quantitative Methods of Social Research at the University of Michigan, Ann Arbor, MI. In spring 2005, she was a research fellow at the Department of Sociology, Cornell University, Ithaca, NY. She is currently employed as a postdoctoral researcher at the Department of Sociology of Utrecht University.

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