Asymmetric dependence and its effect on helping behaviour in work groups

by

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I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Two teams in a large American software company were designed to interact in an interesting way: the first team (called Application) wrote the code that customers used; the second team (called Platform) wrote the code that the Application team used. Application depended on Platform in order to complete their tasks on a daily basis, but Platform did not depend on Application. A case study of the two teams revealed evidence of a power imbalance and intergroup conflict. The data indicated that the dependent (Application) perceived this intergroup conflict, while Platform did not; that Platform failed to prioritize Application's requested work; and that Application expected Platform to "do things" for them, while Platform expected Application to "refrain from doing things" to them. It was argued that the differences found in perception, prioritization, and expectation where, in part, the result of the asymmetric dependence itself.

The case study was used to generate questions about the effects of task-dependence on interpersonal work relationships. The management, social psychology, and behavioural economics literature was unclear and contradictory about how task-dependence would affect helping behaviour. Situational affordances and Heider's balance theory were used to explain how task-dependence and expectations impel helping behaviour between coworkers. The approach recognizes that there are individual dispositional and motivational explanations for helpful behaviour, but these explanations can be improved with a situational perspective which accounts for the force of social expectations.

The theoretical model was tested using an experimental card-game. The card-game was designed so that the task would remain the same while three factors of task-dependence were manipulated: level of dependence (low vs. high), mutuality of dependence (asymmetric vs. symmetric), and reward interdependence (individual vs. group). The goal was to isolate these aspects of task-dependence and measure their effect on helpful behaviours and intragroup conflict. The results indicated that as the level (the amount) of dependence increases, the amount of intragroup conflict increases, but so does the number of helpful behaviours. As the mutuality of dependence changes from asymmetric to symmetric, the number of helpful behaviours increases, but the intragroup conflict decreases.

The experiment deepens the findings of the case study: asymmetric dependence is associated with intragroup conflict and it presents a situation where the more powerful of the two is less inclined to give help to their dependent. Unexpectedly, however, if the level of the dependence increases, the more powerful of the two will offer more help. These findings contradict the predictions of social exchange theory, interdependence theory, and the power and influence approaches. Balance theory offers an explanation: a request for help coming from a co-worker in great need creates an imbalanced cognitive situation, one with

more tension than the situation created when a request comes from someone less dependent. One way the help-giver can relieve their cognitive tension is to offer help; helping a co-worker satisfies the co-worker's expectations, thereby balancing the help-giver's cognitive situation. The experiment also demonstrated that a high level of task-dependence is necessary for helpful behaviours to increase; without the ability and opportunity to help afforded by task-dependence, greater social expectation will have little effect on the amount of helping behaviour.

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Dedication

For Yukie, Hina, Mai, and my parents.

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Chapter 1

Introduction

A large software company recently split one of its product teams in two. The team had grown from 25 people to 300 in two and half years, and in order to manage the growing complexity they were separated, moved into different buildings, and placed under different general managers. The two teams were then considered separate entities, with different reporting, measurement and reward structures. The restructuring may have solved the immediate management issues, but there was one problem: the two teams still worked intimately on a single product.

The general managers tried to split the teams intelligently. Upper management in this company are seasoned software developers and company veterans, and they split the teams based on accepted software engineering principles (Parnas 1972). One team was responsible for the customer-facing code (the "Application"), and the other team was responsible for the invisible server-side code (the "Platform"). Application depended on Platform for their code to work on a daily basis, yet Platform did not depend on Application for their day-to-day work. The teams were designed to be asymmetrically dependent in order to minimize the impact of changes, which is known as modularization, information hiding, or a separation of concerns. In short, if something on the Application changed, the Platform group didn't need to know about it. This enabled the two groups to work as independently as possible, which allowed them to develop the product concurrently with a minimum number of critical dependencies.

A proper separation of concerns is considered to be the foundation of good software engineering practice (Larman 2002). But is it good social engineering practice? Asymmetric relationships are rife with problems, including conflict, anxiety, threats, coercion, insecurity, and mistrust (Kelley et al. 2003, p. 257). The Application team reported some of these problems. They noted that Platform had the ability and power to determine whether or not Application features were developed on time and under budget. One Application team

member highlighted the imbalance, "I feel like they lose sight of the fact on how much they affect us. So I think that it's quite clear that we're dependent on what they're building, but I think they forget that we're as dependent on it as we are." Another member also noticed the asymmetry, "We're consuming their stuff, we're not really giving them anything. So there's nothing that they really need from us or want from us. We want stuff from them and we expect stuff from them."

Overall, Application viewed their relationship with Platform negatively, reporting a high number of unhelpful behaviours from Platform. Platform on the other hand perceived their relationship to be more balanced, reporting a relatively even number of helpful and unhelpful behaviours. Underlying their interactions was an inter-group conflict, pernicious in its effect and a deep concern for the company's management. An Application team member described the conflict: "Honestly, it's been a real struggle working the Platform team, that's been one of the biggest problems we have." Another noted, "So, I think that everyone is aware that there is a lot of tension between our two teams. At least I definitely see it on the Application side."

Can these problems be attributed entirely to the individuals and the idiosyncracies of a high-tech company's intense development schedule? Or can some of the problems be a consequence of the way that the teams were designed to interact? To what extent can the behaviours and conflict be caused by the structure of the task-relationship itself? In other words, if a company designs teams to be asymmetrically dependent, should they be surprised if they find conflict, regardless of the individuals involved?

Asymmetric dependence has been found to result in a number of negative consequences in the context of interpersonal relationships, but there is a lack of understanding of how asymmetry effects work teams in organizations. This dissertation attempts to create a multidisciplinary understanding of how asymmetric dependence could influence helpful behaviours and conflict between task-related individuals. Organizational approaches, such as those found in organizational citizenship behaviour, role theory, social norms, and social exchange theory, are compared with social psychological approaches, such a interdependence theory and work on power and influence. I also discuss recent research in behavioural economics, which helps deepen our understanding of the organizational and social psychological findings. I found that the results from empirical research and the hypotheses derived from theoretical work offer contradictory explanations for how task-dependence influences behaviour.

In an effort to clarify and explain these apparent contradictions, a new approach is presented combining situational affordances (Gibson 1977; Reis 2008) and balance theory (Heider 1946, 1958). The approach proposes that task-dependence is a situation that affords

more helping behaviour, and it is a situation that causes the help-receiver to increase their expectations for help. Those expectations create tension within the help-giver and give rise to forces acting on the help-giver to behave accordingly. Those forces, and the conditions under which they act to produce helping behaviour, are explained by Heider's balance theory. An experiment is developed to test the theory and resolve the current inconsistent hypotheses and findings in the literature. The experiment combines aspects from social psychological experiments with those of behavioural economics experiments. The results are encouraging and help explain and deepen the findings from the case study. The theory and results also help explain recent findings in behavioural economics which have demonstrated that expectations alone are enough to encourage prosocial behaviour.

Chapter 2

Case Study: Some effects of asymmetric interdependence between software teams

The case study presented in this chapter served as the inspiration and motivation for the theory and experiment portions of this dissertation. The dissertation's topic, the effects of interdependence on behaviour, was only realized during the analysis stage of a previous study. That previous study investigated the coordination mechanisms used between two software development groups. The current case study, on the other hand, was focused on the interpersonal relationships between those two groups. This chapter provides a background on the circumstances of the first study and presents the results of the current study.

Two groups from a large software company were interviewed over a three month period in the summer of 2007. Like most software teams, the two groups had problems coordinating their work. But the data indicated that at least some of these problems may have been due to how the software teams had been arranged in the organization. The first team had been designed to depend on the second team, and the second had been designed to not depend on the first. The organization had set up a one-way dependency, also known as an asymmetric interdependency.

In the case study that follows, I have presented evidence that it was this asymmetric interdependency that influenced the way the two teams interacted. I have argued that the asymmetry partially influenced the teams to perceive their interaction very differently, to prioritize their work differently, and to expect different types of behaviour from the other team. In order to understand why and how the organization placed the teams in an asymmetric interdependence, the first section provides a short background on how software teams manage their dependencies.

2.1 Dependencies in software development

Software engineers build systems larger than a single person can handle alone, but to do so they need to somehow split the system into smaller parts. Once they've split the system into parts, they need to coordinate the actions of those parts (system-level) and the actions of the people who are building those parts (social-level). In software engineering, system-level interactions are referred to as dependencies, so- called because the functioning of one component depends on the functioning of another.

Understanding the dependencies between components in a project is important, because when a component is changed, often those components that depend on it must also be changed. In extreme cases changes in one component often will break the components that depend on it. This matrix of dependencies is not unlike that which exists in mechanical systems, where components that physically interface must be coordinated during design to fit properly (Sosa et al. 2004). Indeed some software engineering experts have argued that software systems are the most complicated and interconnected systems ever built by man, partly because software has fewer physical constraints which allows more complicated dependency networks (Brooks 1995).

The software engineering community has traditionally viewed dependencies between components as the most pernicious problem of software engineering. Even introductory software engineering textbooks focus on methods to cleanly encapsulate functionality (modularization), often using an object metaphor (see for example, Larman 2002; Martin 2003). Writers outside of the software field have also recognized that the same principles are at work in wider organizational design; Baldwin and Clark (2000) argue from the strategic management perspective that modularization encapsulates complexity and hides design decisions behind standardized interfaces.

The emergence of formal "design patterns" was an attempt to codify and communicate software design knowledge, and these focused almost exclusively on ways to cleanly separate and isolate components (Gamma et al. 1995). At their core, design patterns are well-known ways to maximize "separation of concerns," so that a change in one component has minimal impact on those that depend upon it (Parnas 1972). The most difficult of all dependencies are cyclical, where a section of component A depends on a section of component B which depends on a different section of component A. These are known as cyclical dependencies, and many design patterns are devoted to breaking them (for example, see the Dependency Inversion Principle Martin 2003, pp. 127-135).

It is understood in the software industry that however well one might initially design a system, the initial decomposition is difficult, and even the best designers cannot anticipate

all of lines of interaction that may be required in the future. The result is informal and unanticipated interaction between groups which were not specifically designed to interact (Olson and Teasley 1996; Grinter et al. 1999). And although they may have not been designed to interact, researchers have found that teams tend to be organized along the lines of the components that they build, either intentionally or unintentionally (Conway 1968; Herbsleb and Grinter 1999a,b; Cataldo et al. 2008). For example, Team A takes responsibility for component A, and Team B takes responsible for component B. Therefore if component A depends on component B for its functionality, Team A's work depends on Team B's work.

Since much of software design is devoted to reducing the impact of dependencies, and designers try to avoid cyclical dependencies like buried mines, it is common to organize teams so that Team A's work is sent to Team B. Ideally, Team B does not send its work output back to Team A. If the designers have done their job correctly, changes are propagated from A to B, but *not* from B to A. In this situation, B depends on A for aspects of their functionality, but A does not depend on B for any of theirs. This is referred to as an asymmetric interdependency, or a one-way dependency, and it is ideal from a software engineering point of view.

The case study reported in this chapter describes a real world software project, within which two teams were designed to be asymmetrically interdependent. Using qualitative interview data, I present evidence that the asymmetry may have caused a difference in how the two teams perceived their interactions, how they prioritized each other's requests for help, and a difference in what they expected of the other group. This hypothesis-generating study was exploratory in nature and stimulated by unexpected findings, and as such the data cannot support any definitive conclusions (Gersick 1988). Rather, the case study presents the empirical impetus for the theory development in Chapter 4 and the experiment study in Chapter 5.

2.2 Background of the Study

The case study presented in this chapter grew out of a qualitative study conducted over a summer internship at a large software company in the United States. The "Company" is one of the world's largest software developers with expertise and top products in almost every major software market. I was hired as a summer intern at the Company's research and development division. The research group I was hired into had a unique goal among the dozens of other groups in the R&D division. The group was trying to understand how programmers worked together to develop large software systems, a field which is now known as the "human aspects of software development." With a deeper understanding of these human aspects the group would develop new software tools to help programmers work more effectively, and

ultimately those tools would reach the commercial marketplace.

With this study the group wanted to understand how a software team following the Agile software development methodology would coordinate their work with a team following a more traditional waterfall methodology. However the group could not find any teams who were both following a strict form of Agile software development and who were open to participating in a research study.

The group eventually did find a team that was willing to participate in the study. Their development methodology was a hybrid of agile and waterfall: they worked on plan-development-test cycles of 6 to 8 weeks, but they did so within the larger constraint of a plan-development-test cycle of one year for their overall project.[1] This team was the "Application" side of a large internet product which provided web services for small businesses. The product offered a light and easy to use alternative to large enterprize resource management (ERP) systems, combined with services found in turnkey web ecommerce systems. The service provided centralized and web-accessible versions of an enterprize mail server, a document management and sharing system, an online store, order processing system, easy to use online advertising, and so forth. The Application team was responsible for all the customer-facing code; if the customer could read it, click on it, or use it, the Application team was the one responsible for how it looked and the functions it performed.

In order for the Application team's program to function they needed a set of back-end software, which included databases, networking code, and all of the customized software that allowed documents and mail to be shared, orders to be processed, and advertising to be tracked. The "Platform" team provided this functionality.

The two main groups have been labeled Application and Platform, labels which confer a dependent-dependee relationship on the groups. An application depends on its platform for implementation; the platform has very little dependency on its application, other than a very high-level group goal of "success," which is far removed from having an impact on day-to-day interactions. The groups were labeled this way not to bias the discussion of their relationship, but rather as descriptive of their interactions. Their actual group names give no hint to their dependent relationship. In their working relationship, however, the two groups are highly asymmetric. The Application group consumes the entire output of the Platform group, and the Platform group consumes no output of the Application group. At the time of the study another group had recently started to develop a second application on top of

[1] The differences between "waterfall" and "Agile" software development methodologies are contentious and often superficial; most differences are due to how long an iteration lasts. An iteration is defined a closed loop of planning the functionality, development that functionality, and testing that functionality—hence the term "plan-development-test cycle." Teams labeled waterfall have iterations that last from six months to multiple years. Teams labeled Agile try to keep iterations between two weeks to two months. See Martin (2003), Boehm and Turner (2004), and Larman (2005) for comprehensive overviews on the Agile vs. waterfall debate.

the platform, which further increased the asymmetry; Application was then not even the sole consumer of Platform's services.

After meeting the Application team, the research group shifted its focus from Agile software development to coordination. The group was interested in finding out how these two teams kept each other up to date on the progress of their software, the changes that occurred, their future plans, and all the minutiae which allowed the two team's software to work together—this is what is meant by the term "coordination" in software development. The study's focus shifted to understanding which physical and software artifacts they used to maintain awareness of what other the other team and team members were doing. The study was to determine the mechanisms that the teams used to coordinate their work, and then build new or improved versions of those mechanisms. The research group decided that the best way to investigate this problem was through qualitative interviews.

The interviews were coded and a number of different categories were identified that represented helpful behaviours and unhelpful behaviours related to coordination. These categories were used as the basis for a survey sent to a random sample of 2500 technical employees of the Company, from which 775 responses were gathered.

The detailed results of the analysis and survey related to coordination mechanisms is not presented here, as coordination mechanisms are not the focus of this dissertation. However, as an example, we found that developers used a bug tracking system "ProjectStudio" to send notes and reminders to each other. A developer would file a "bug" against another developer that said, "remember that I need feature A's interface specification by Friday." This bug would appear on the target developer's computer acting as a reminder of something they needed to do. From a software engineering standpoint, and particularly a tool-building standpoint, this was interesting because the software developers were using a coding tool (the bug tracker) for communication. That type of communication "should" have happened through email, a public wiki, a public whiteboard, or some other communication tool.

During the end of the interview analysis I noted an unexpected problem between the teams. It was clear that the two teams had problems communicating with each other and deciding on how to fit their two halves of the software project together. This was not a new finding, as it has been long known that inter-team coordination is a difficult aspect of large-scale software development (Weinberg 1971; Curtis et al. 1988; Brooks 1995; Kraut and Streeter 1995). As mentioned before, it is considered good software engineering practice to modularize and separate concerns, such that components are not placed in circular dependencies. Good software engineering practice would expect Application to depend on Platform's output, and Platform to be relatively independent of Application. It was unexpected, however, that this asymmetric interdependence would have a social cost attached to

it, a cost that that would affect the team's ability to work together.

The following questions inspired a reanalysis of the interview data: Does the asymmetric interdependence between teams affect their ability to get their work done? In what way? The following analysis attempted answer these questions.

2.3 The Company's Organization

The simplified organizational chart for the Internet Product Group (IPG) is given in Figure 2.1.[2] At the time of the study, the product team was 3 years old and had grown to 300 employees from its initial 25. Product groups in the Company are overseen by Corporate Vice Presidents (CVP) but are lead on a daily basis by General Managers (GM). GMs oversee the work of their three Group Leads. A Group Lead acts as a Lead and oversees the work of the other Leads within their role. Technical employees at the Company fall into three distinct roles: Developers (Devs), Developers in Test (Tests), and Program Managers (PMs). A Dev Lead, Test Lead or PM Lead manages other members of the same role. Until this point the product groups are arranged as a functional organization. Individual product features are handled through a matrix-style system. Features are owned and developed by cross-functional teams called Feature Crews, consisting of a PM, Dev and Test, who act as peers. A PM prioritizes the features that will go into the software, and writes the high-level feature specification that Devs and Tests will use for their work. A Dev is responsible for software design, writing new features and fixing bugs. Tests translate feature specifications into test cases and test the software. The Company typically promotes technical people to management roles, so that most CVPs, GMs, and group leads are former Devs, Tests, and PMs.

The right side of the organization chart diagrams the portion of the Company's India development office that was allocated to IPG's product. Having a small portion of the IPG product developed overseas caused a tremendous amount of coordination difficulty. But the interview data gathered from these offices were not used because their team was not involved in the main Application-Platform interaction. Likewise, there was a section of the Application group located in Boston, but data from those interviews was not used. It was found in the interviews that the Boston group's location was a dominant feature of their interactions with the rest of the IPG group, and issues of location overshadowed those positive or negative effects that may have been attributable to the asymmetric interaction with the Platform group.

[2] For a more accurate but more complicated version, see Figure A.1.

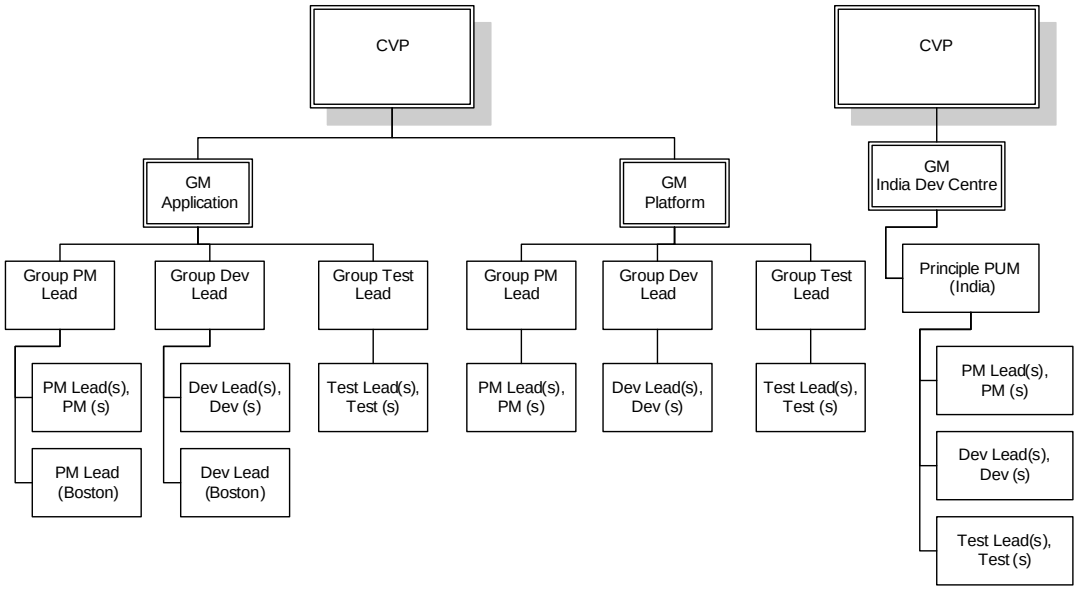


Figure 2.1: Official organization chart (simplified)

2.3.1 The task-related social network

At the start of the previous year's iteration, the IPG GMs decided on a list of features to implement. The features were assigned to the group responsible for them (Application or Platform) and work began. Once a particular feature had been sufficiently specified and prioritized it was assigned to a feature crew. The feature crew (a PM, Dev, and Test) worked on the piece of functionality together. Asked to draw a graph of their interactions, PMs, Devs and Tests would invariably list the members of their feature crew first. The second most frequent interactions were with members of other feature crews in their respective group (e.g., Application PMs, Devs and Tests would interact with other Application PMs, Devs and Tests, and Platform PMs, Devs and Tests would interact with other Platform PMs, Devs and Tests). Their third most common interactions were with members of the opposite group (e.g., Application PMs, Devs and Tests would interact with Platform PMs, Devs, and Tests). The forth most common interactions were with outside stakeholders, such as subsidiary companies or partners that were providing a service or consuming one of the IPG's services.

The Company organized its product group members as a functional organization, but in practice the IPG group followed a matrix organization. Adding to the complication, the IPG was split into Application and Platform groups, placed under different GMs, and the Platform group was moved to a neighbouring building (due to a lack of office space). The separation was more than physical; the Platform group was now in charge of all the software components that the Application needed for their code to work. The interview data illustrates the difficulty that the two teams encountered after the split.

2.4 Method and Participants

This study was conducted during three months, June through August 2007, and consisted of 31 one-hour interviews with 26 members of the IPG. The interviews followed a formal semi-structured "Echo Method" designed by Bavelas (1942). The method has recently been used in studies of organizations to examine task interactions in new product development (Duimering et al. 2006; Safayeni et al. 2008), task structures of engineers (Safayeni et al. 1992), and manufacturing flexibility (Scala et al. 2006). The method elicits the subject's social network of task-based interactions, where the subject is the middle "node" and nodes on the outside represent the individuals, groups or technologies with whom the subject interacts while doing his or her job. Echo questions are then used to examine interactions between the subject and each of the identified nodes. The subject is asked to provide concrete examples of behaviours performed by other nodes that are helpful from the subject's point of view, and examples of behaviours that are not helpful. The exact format of the question was, "When you interact with this person/group/technology, can you give examples of things they do that help you complete your job? How does this impact your job?" To elicit unhelpful behaviours the question was rephrased as, "When you interact with this person/group/technology, can you give examples of things they do that *do not* help you complete your job? How does this impact your job?"

By asking for specific examples of positive and negative behaviours, subjects are encouraged to provide descriptive information about concrete events experienced on the job, rather than ungrounded opinions or stereotypes about others. The questions are specifically designed to limit subjective biases. An additional benefit of this method is that past behaviours are remembered in the context of the subject's task. This adds ecological validity to the behaviours, because they are recalled due to the significant task-related impact the behaviour had on the subject's work (Freeman et al. 1987).

In total, 26 subjects were interviewed: 13 from the Application group (6 PMs, 5 Devs, 2 Tests), 7 from the Platform group (5 PMs, 2 Devs), 3 from Boston (2 PMs, 1 Dev), and 3 from India (2 PMs, 1 Dev). Interviews were face-to-face, with the exception of Boston and India, which were done over the phone. Interviews were audio-recorded and transcribed verbatim, for a total of 460 pages of single-spaced text. The transcripts were used as the basis for this analysis.

Transcripts were coded in a four-pass process. The unit of analysis was a helpful or unhelpful behaviour that had actually occurred and affected the subject's task from their point of view. The coding categories emerged during the coding process in a manner similar to that described by Strauss and Corbin (Strauss and Corbin 1998). That is, previous similar codes were revisited and revised in the light of recent codes, and specific behaviours were

grouped under broader categories of behaviours which emerged from the data. The first two passes coded and revised the codes for behaviours relating to coordination (the focus of the original study). The third pass recoded the data with respect to the focus of the current study, the differences in perceptions, prioritization, and expectations between the Application and Platform group. A forth pass refined these codes in light of the codes from the third pass.

The results of the interviews are best understood as a social network of role interactions (Safayeni et al. 2008). I will present the data from two of the role interactions, the Application PM (AppPM) — Platform PM (PlatPM) interaction, and the Application Dev (AppDev) — Platform PM (PlatPM) interaction. I chose to focus the analysis on these interactions because they represented the main Application — Platform interaction, and because interviews were conducted with both roles involved in the interaction.

2.4.1 Limitations of a case study

There are significant limitations to performing a selected sampling of interactions in a single product group in a single company. This is a small sample and not intended to be generalizable to interactions in other software projects, even within the Company. These are behaviours that happened in this organization, this group, and in this specific context . The data is intended to provide evidence that such interactions have occurred in this situation, and through this data one can generate hypotheses for future investigation (Gersick 1988; Charmaz 2006).

In particular, however, this case study suffers from two more practical limitations: the original study was not focused on asymmetry in interdependence, and the samples were unbalanced. First, the original interviews were targeted to elicit data about inter-team coordination, coordination mechanisms, and ways in which software teams might be better able to coordinate through the use of new software tools or physical reorganization. As such, the issue of asymmetric interdependencies was never explicitly asked of the participants; the data used in the current case study was gathered from example behaviours relating to the first study's topic. The consequence of this limitation is the low number of behaviours reported in some interactions (for example, see Table 2.2). Two, it was difficult to get a symmetrical sampling of participants from the Application and Platform groups. There was a hard time limit for the original study and we ran into difficulty scheduling interviews with programmers (these interviews took place near the end of a product cycle, "crunch time"). As a result, much of the interview time was spent on non echo questions related specifically to coordination mechanisms, there are more Application members interviewed than Platform, and overall fewer interviews than would be ideal.

2.4.2 Point of view and aggregating behaviour

The interview data contains behaviours which were reported by a particular subject. That subject is reporting a behaviour from their Point of View (POV). From their POV they are reporting a "Sender" role's behaviour (so called because the behaviours were "sent" to the subject in the past). By gathering POV data from multiple people in the same role with respect to another role, the data becomes richer and more reliable. The behaviours can then be aggregated based on the POV role. For example, if there were three Application PMs interviewed, and they identified Platform PM as a significant interaction and gave example behaviours performed by the Platform PMs, summing those behaviours would give an overall view of the Application PM — Platform PM "link" from the POV of the Application PM role. The term "link" is used to describe an interaction between two roles.

An overall measure of the effectiveness of an interaction can be computed by taking the behaviours reported by subjects from a particular role, and summing the number of helpful behaviours and dividing by the number of unhelpful behaviours from a particular Sender role. This is referred to as the link's Interaction Effectiveness (IE) from that POV role (Safayeni et al. 2008). It is then possible to compare the differences in one group's perceptions of the other by comparing the IE ratios. For example, with a link between A and B, A—B: from A's POV the IE is 1.5, and from B's POV the IE is 0.7. In this case the evidence indicates that A perceives B to be more helpful, and B perceives A to be less helpful.

A benefit of this measure is that it is a ratio, so that if there are five subjects from role A, but three from role B, the IE's are still comparable as a measure of the role's perception of the other role. A limitation of unbalanced samples is that, as usual, reliability increases as the number of the subjects in a POV increase.

In order to give a transparent view of the interview data, behaviours are aggregated by category and by number of helpful versus unhelpful. For each behaviour category cited I will give the percentage of subjects in that role who mentioned the behaviour (N=x%), and the number of times a *unique* behaviour was coded into that category (freq=y). Also for transparency, when possible the subject's own words are used to describe the behaviour category. The subject responsible for the quote is identified in brackets after the quote. For the most part, category names are self-explanatory, and quotes from the subject should remove any ambiguity.

2.5 Results

Overall, I found the interaction between Application and Platform to be difficult and filled with tension. In Application's own words:

> Honestly, it's been a real struggle working the Platform team, that's been one of the biggest problems we have. [AppPM6]

> [The issue] was definitely escalated and I think that there is definitely some tension at the higher levels as well. So, I think that everyone is aware that there is a lot of tension between our two teams. At least I definitely see it on the Application side. [AppPM2]

Two subjects mentioned asymmetry in their interview. One Platform PM noted that some of the bad interactions may be because his group is a platform, and one Application PM explicitly mentioned that the dependent-dependee relationship may be an underlying cause:

> We're consuming their stuff, we're not really giving them anything. So there's nothing that they really need from us or want from us. We want stuff from them and we expect stuff from them. [AppPM3]

2.5.1 Analysis of AppPM—PlatPM link

POV Role		N	Sum	
AppPM	Helpful Behaviors	4	4	
	Unhelpful Behaviors	6	31	
Interaction Effectiveness				0.13
PlatPM	Helpful Behaviors	3	9	
	Unhelpful Behaviors	2	8	
Interaction Effectiveness				1.13

Table 2.1: Number of helpful and unhelpful behaviours from the other role, from each role's point of view (POV) ("N" is number of unique interview subjects, "sum" is number of unique behaviours within each category)

The overall summary in Table 2.1 shows that the interaction is perceived to be worse by AppPM: AppPM perceives an IE of 0.13, and PlatPM perceives an IE of 1.13. The following sections describe the behaviours reported from each point of view, both helpful and unhelpful.

AppPM's POV: PlatPM Unhelpful Behaviors

Behavior: *Our critical dependency was not seen as a priority by them [PlatPM]* ($N = 100\%, freq = 10$).

Example comments:

> I feel like they lose sight of the fact on how much they affect us. So I think that it's quite clear that we're dependent on what they're building, but I think they forget that we're as dependent on it as we are... They think it's no big deal on our side, when in fact is is a big deal, from a resource and timing perspective. [AppPM6]

> Maybe they just don't think it's important. But they do a very, very poor job of communicating what the problem is or where I fall in their prioritization. [AppPM3]

> It's hard for me to understand how they prioritize things. I know I've talked this over with [my manager], and he definitely doesn't think that they prioritize things very well, and I definitely would have to agree. They seem to waste a lot of time, and I don't—it's hard for me to put myself in their shoes because I don't understand why they're doing it. I just don't know. [AppPM2]

This behaviour affects AppPM's ability to complete their tasks, meet crucial deadlines, and plan their schedules. For example, because the Platform group didn't perceive Application's tasks as priorities, they didn't "consume" their code first to test if it did what it was supposed to do. As a result:

> It didn't have any functionality and it didn't have the ability to easily add that functionality. So, we basically ended up creating a very large work item for them at the very end of our development cycle, and all of our developers were stalled waiting for them, and it was a huge problem. [AppPM2]

This behaviour so affects AppPMs that they start to perceive other behaviours in terms of how it affects their priorities, even when such behaviours may have been the result of other factors:

> The person in charge of specifying the feature, he was a contractor who has left for six months. So, it seems like if I was going to develop a feature that a bunch of other people would rely on — or if I was a manager and I was looking at all the people to assign to a feature, I would definitely not assign the feature that everyone relied on to the person who was going to leave.
>
> But I think even if he stayed, he still specified the feature badly. I mean, you look at this feature and every PM expected it to have the same functionality. It had no functionality. [AppPM2]

From AppPM2's point of view, the feature did not receive the consideration and work it deserved, and this AppPM perceives the cause to be a lack priority on the part of PlatPM. This perception caused another AppPM to decide that a contract was needed between the two groups:

> So maybe spelling it out a little bit more, almost like a customer service contract between the [Platform] and [Application] PMs would be a more explicit way of making sure everybody's on the same page, and it might have made a couple of my interactions a little bit better. [AppPM3]

The data indicates that the AppPMs feel powerless, they are unable to control or affect how their work gets prioritized by the Platform group. The AppPM's perception is changed by their extreme dependence on Platform group, to the point where mistakes are seen as just another symptom of, "It's a lack of prioritization, a lack of thinking that it's important." [AppPM6]

This behaviour is so prevalent in this role (N=100%) and across roles (see Section 2.5.2) that it is described as a central characteristic of the asymmetric interdependence (differences in priorities, Section 2.6.2). Also observed in this behaviour is the characteristic of differences in perception (Section 2.6.1). This behaviour overlaps with most of the unhelpful behaviours from the AppPM's point of view, to the extent that the other behaviours could be understood as symptoms of the underlying cause of lack of prioritization.

Behavior: *It is difficult to get PlatPM to do what we need them to do* ($N = 100\%, freq = 8$).

Example Comments:

> You have to present a very strong case and it's always difficult when you say, 'Hey, you guys should do this. It would make our job a lot easier.' It's just—it's a difficult ask unless you can say, 'Well, this is how it benefits you.' [AppPM4]

> We basically said, 'This is what we need, wouldn't it be great if someone like you developed it and made it extensible so other features could use it?' ... It's just they definitely didn't see it as a high priority, and it's definitely not on their list of features that they want to get out the door. [AppPM2]

This behaviour directly affects the AppPM's ability to complete their tasks and plan their product features. Many of Application's plans are contingent on functionality provided by Platform. Thus, if any of the current functionality gets bumped, delayed, or cut, it directly affects AppPM's current work. Similarly, if any planned Platform features are changed, it affects AppPM's plans, schedules, and the commitments they've made to other groups, such as marketing.

A consequence of this behaviour is that the Application group is forced to take on work that, from a architecture design point of view, should be part of Platform's responsibility. For example:

> I feel like in general Application has to work around Platform. Like they just won't do something for us, and we'll say, "Fine," and we'll do it on our own, and share it amongst our little feature group. [AppPM2]

> They thought that building [the feature] database would be a low more work and they only wanted to build a [more simple] database that got them to complete their task circles or priorities. They didn't want to do stuff to help us make it a better [feature] is kind of what it comes down to. [AppPM3]

Platform is responsible for components that Application relies on complete their tasks. The data suggests that a consequence of this division of responsibilities is that Application often requires Platform to make changes and add functionality that Platform does not perceive as important. In this case, Platform has its own goals and responsibilities that are met regardless of whether or not Application gets its request fulfilled. Platform is content with a component that does x, while Application needs a component that does $x + y$. As a consequence, AppPMs find it difficult to get their features included into Platform's plans, which affects their ability to deliver their part of the product on time, under budget, and with the desired features.

This behaviour is closely related to the problem of priorities; if the Platform group highly prioritized Application's work items, they likely wouldn't have as much trouble getting Platform to do as they needed. It is a highly significant behaviour, and a central characteristic

of the asymmetric interdependence, included as part of the differences in priorities (Section 2.6.2).

Also closely related, and a possible consequence of this behaviour, is the Hot Potato behaviour.

Behaviour: *Hot Potato features* ($N = 50\%, freq = 7$).

Example Comments:

> But all the bugs were coming over to us and it's been a little bit back and forth, and then they decided they didn't want to do anything in [the last version], so [the feature] came back to us, but now it's going back to the Platform team. It's just one of these hot potatoes that nobody wants to deal with. But it really, logically belongs under their charter. [AppPM3]

> Ultimately it wasn't prioritized as a feature in [next version]. So they budgeted zero for improvements in [next version] even though they owned [the feature's] UI and [the feature's] database... Management said '[Platform] can't do this, they're not staffed to deal with this at all. Give it back to [Application] because they know more about it, presumably, because they owned it in [last version]. And then we'll move it back to [Platform] [next version].
>
> So that's kind of why it's gone back and forth so many times, and I'm cynical enough at this point to believe that post [next version] they won't own it. That they will not take the responsibility to own it. [AppPM3]

The result of features being bounced around is conflict between the teams and confusion. Conflict emerged in this situation in part due to the problem of feature ownership. A PM reported:

> And the [Platform] PM came in and being the strong PM that he is, he started tracking it for both their team and then also my part, so that sort of in the end made me feel like my work was cheapened a little bit... I didn't know how much I should do, so because of that, it led to ambiguity. It led to a few delays and it didn't turn out as well as I wanted it to and it's because of this ownership thing. [AppPM4]

This situation resulted in confusion and difficulty for Application. An AppPM reported situations in which they didn't know who owned what, or didn't understand how the ownership was determined:

> It's hard to, one, delineate where the ownership line lies, and, two, it's redundant to have two people on two separate teams own the same thing, so when that's the case then one owner needs to be decided, and how that's done is very arbitrary. [AppPM4]

This confusion led to time wasted while finding and negotiating responsibilities. [AppPM2]

A Hot Potato refers to situations in which Platform should logically own a feature, to keep with the architectural design of the product and how the groups have been split. However, Platform doesn't need it, use it, want it, or build it in a way that is useful for Application. When Platform stops work on a feature, Application is forced to take ownership, even though it is Platform that logically should own and drive it. This overlaps with the priorities behaviour mentioned above.

In essence, because Application is so critically dependent on Platform, Platform makes decisions that affect Application. Application is left without recourse. Taking ownership of the feature in dispute fixes the problem. Other possible options are a customer service agreement [AppPM3], or escalation up the management chain to solve disputes [AppPM2] (see Section 2.5.1 for AppPM's point of view on escalation).

Behavior: *They don't communicate well with us about our dependencies* ($N = 33\%, freq = 5$).

> Typically what happens is the Platform team, because they own all these features they don't communicate them well enough to us, if they're making a change to how provisioning works, or how the content systems work, they don't do a good job of communicating that to us [AppPM6].

This behaviour is similar to the previous Hot Potato behaviour; both involve the dependent (Application) not receiving the level of care and helpful behaviour they expect from the team that they depend upon (Platform). The same solutions apply to both the Hot Potato and lack of communication behaviours.

AppPM's POV: PlatPM Helpful Behaviors

Behaviours: *Responsive to my emails about my dependencies* ($N = 33\%, freq = 2$). *It's easier to get what we need from Platform compared to external teams* ($N = 16\%, freq = 1$). *Status meetings are helpful, but I only go when I need something* ($N = 16\%, freq = 1$).

The data indicates that with respect to its dependencies, the AppPMs perceive far more unhelpful than helpful behaviours, indicating a very poor relationship from their point of view. Two PMs reported that of the PlatPMs they interact with, only two are helpful over email. The two PlatPMs respond quickly and put the AppPM in touch with their dependency. An AppPM notes that even though the relationship is difficult with PlatPM, it is still "easier to get what we need from Platform compared to external teams" [AppPM3].

The comment that "status meetings are helpful, but I only go when I need something" [AppPM4] is echoed by an PlatPM as an unhelpful behaviour (see Section 2.5.1).

PlatPM's POV: AppPM Unhelpful Behaviors

Behaviors: *Sometimes they don't show up to status meetings, so we can't help them out* ($N = 25\%, freq = 1$). *They changed their requirements* ($N = 25\%, freq = 1$). *Maintaining communication is difficult* ($N = 25\%, freq = 3$). *They have trouble conforming to my scenarios* ($N = 25\%, freq = 2$). *Sometimes they don't show up to status meetings, so we can't help them out* ($N = 25\%, freq = 1$). *It's tough to balance my needs with theirs* ($N - 25\%, freq = 1$).

Example Comment:

> There's a little bit of tension in my thinking of two things—I'd like to interact more with them so that I know the direction they are taking so that we can build the right things on the platform. On the other side, is that the best value for me or should I just focus on the platform and the interaction we are having is good enough? So I don't know the answer to that. [PlatPM1]

The example quote indicates that the PlatPM is being pulled between their own group's goals and tasks and Application's tasks. PlatPM1 recognizes that Application is indeed wholly dependent on Platform, and that this recognition affects how the PM tries to balance his work load.

Platform PMs mentioned that there are so many AppPMs depending on them that they lose track of who they need to speak with:

> There were some follow-ups, but it wasn't as tight as I hoped it would have been…I wish that there was more pulling of information from their side instead of me pushing information and status updates to them…The one thing, and it's the nature of the platform–partner interaction, I wish that they would do more of the tracking on the status rather than I going to them. I wish that there was more pulling of information from their side instead of me pushing information

> and status updates to them. But then again I guess that's just the nature of the platform. [PlatPM2]

The Platform PM described situations in the past that illustrate the effects of an asymmetric interdependence; Application is wholly dependent of Platform, and when Platform changes, so does Application:

> We need to make changes on the platform and we need the apps they've already coded to be updated to act accordingly to the new feature of the platform. This requires a lot more interaction because at that point it's me setting those scenarios and asking them to conform to it. [PlatPM2]

The Platform PM realizes that they are the ones controlling the situation, so much so that two of their unhelpful behaviours are: 1) maintaining communication is difficult because there are too many people depending on them to keep track of, and 2) AppPMs don't follow my scenarios close enough.

Platform PM's expectations about their role and the appropriate behaviour for Application PMs is one of the main sources of conflict between the two teams and a central characteristic of their asymmetric interdependence (differences in expectations, Section 2.6.3).

PlatPM's POV: AppPM Helpful Behaviors

Behaviour: *Everything is fine with their group* ($N = 25\%, freq = 1$). *Their requirements are clear and formal* ($N = 50\%, freq = 4$). *They follow up to remind me of their dependency* ($N = 50\%, freq = 2$). *They accommodate our needs by cutting their functionality* ($N = 25\%, freq = 1$). *They don't escalate unnecessarily* ($N = 25\%, freq = 1$).

The data indicates that from the Platform PM's point of view the relationship is not as bad as the interviews with the AppPMs indicated. For example, PlatPM4 perceives the relationship to be fine:

> We have our status meeting where we sync up [with AppPMs] ... They're good about asking questions in email. They [his subordinate PlatPMs and the AppPMs] are comfortable with each other [PlatPM4].

From the PlatPM's point of view, all AppPM behaviours considered helpful relate to being good dependents. That is, clear and formal requirements allow PlatPMs to keep the

relationship regulated, formal and tracked: "The characteristic of good requests from Application is that it's more formal and there is a contract" [PlatPM1]. It is helpful when the dependent reminds them of their dependency because, "sometimes you're so busy with multiple things, it helps if they ping you" [PlatPM1]. It is helpful when a dependent, "tries to understand what our constraints are and not escalate unnecessarily" [PlatPM2].

The data indicates that the Platform PMs view the relationship to be one where it is helpful when the dependent makes the compromises, and accommodates the PlatPM's preferred method of work. The differences in how the two sides view the interaction and expect the other to act is a main characteristic of their asymmetric interdependence (differences in expectations, see Section 2.6.3).

2.5.2 AppDev—PlatPM link

POV Role		N	Sum	
AppDev	Helpful Behaviors	1	4	
	Unhelpful Behaviors	2	7	
Interaction Effectiveness				0.57
PlatPM	Helpful Behaviors	1	1	
	Unhelpful Behaviors	1	1	
Interaction Effectiveness				1.00

Table 2.2: Number of helpful and unhelpful behaviours from the other role, from each role's point of view (POV) ("N" is number of unique interview subjects, "sum" is number of unique behaviours within each category)

The summary of the AppDev — PlatPM link in Table 2.2 shows that the interaction is worse from the point of view of the AppDevs: AppDevs perceive an IE of 0.57, and PlatPMs perceive an IE of 1. The following sections describe the behaviours reported from each point of view, both helpful and unhelpful.

AppDev's POV: PlatPM Unhelpful Behaviors

Behavior: *Hot potato features/negotiating responsibility* ($N = 33\%, freq = 4$).

Example:

> Application and Platform were originally one team... There are some features that land in the middle ...one or the other teams should take responsibility fully and take over. [AppDev1]

Behavior: *Our critical dependency was not seen as a priority* ($N = 33\%, freq = 1$). *Can't get good communication from them regarding my dependency* ($N = 66\%, freq = 2$). *Difficult to sync up our requirements with their plans* ($N = 33\%, freq = 1$).

The behaviours reported by AppDevs are extremely similar to those reported by AppPMs. The impact is similar as well; Platform behaviours cause significant changes to Application's task situation. For example:

> So, we're totally broken because the old thing doesn't work anymore and the new thing isn't done yet. [AppDev1]

> If your deadline is at the end of this week, and then there's suddenly a change where you need to add 3 days of extra work. There is no room to move that deadline, because there are cascading affects downwards. We can't afford to postpone the deadline. It will extremely impact work-life balance. [AppDev2]

The first three behaviours are the same as reported by PMs. With Developers, the behaviour is slightly more specific to code dependencies, but the impact and meaning of the behaviours remain the same. As with AppPM, AppDevs perceive it to be very difficult to get their requests handled by Platform PMs. One of the choices to handle this dependency is to take over the code, but, "we can't really do anything with it, because it's in their code base or it is half in their code base and half in ours." [AppDev1] The behaviours in this interaction indicate that in splitting up the two groups, the organization has placed many constraints on the ability of Application to control the code that they depend upon.

AppDev's POV: PlatPM Helpful Behaviors

Behaviors: *They let let us know the status of our dependencies* ($N = 33\%, freq = 1$). *We can provide feedback on what they're going to do* ($N = 33\%, freq = 2$).

Example:

> One thing I think they're doing a good job of is that they publish the important design documents to us as well. We get a chance to provide feedback or at least get a heads up on what they're going to do ... They also communicated how things are going to be carried out in the schedule. [AppDev1]

Two relevant findings from this interaction are the relative lack of helpful interactions compared to unhelpful from AppDev's point of view, and the language that AppDev uses to

describe helpful behaviours from PlatPM. The data indicates that the AppDevs are completely dependent upon the Platform team, to the extent that they find it helpful that the Platform team "at least" gives them a heads up on what they are "*going* to do" [my emphasis]. This gives further indication that in this product group the Application team depends heavily on the Platform team, which results in behaviours characteristic of asymmetric interdependence (differences in expectations, Section 2.6.3).

PlatPM's POV: AppDev Unhelpful Behaviors

Behaviors: *Difficult to manage so many dependencies* ($N = 25\%, freq = 1$).

> The interaction there is a little harder because it's not a one-to-one basis . . . When I have to do this it's usually from me to a bunch of Application PMs, and Devs. That one is really hard, I don't know how to make it easier yet, because there isn't a single person to follow up with.

This behaviour is similar to the unhelpful behaviour "Maintaining communication is difficult" mentioned by Platform PMs in Section 2.5.1. Similarly here, the issue is that there are too many people depending on PlatPM, and PlatPM has trouble keeping everyone updated.

PlatPM's POV: AppDev Helpful Behaviors

Behaviors: *Their communication is formal* (N=100%, freq=1).

> Bugs are really helpful, because they're in the database . . . you have that bug on your plate and there's a lot of governance around bugs in [the Company] in general. So that's a good thing if it's a bug [PlatPM1].

This behaviour is the similar to the helpful behaviour "Their requirements are clear and formal" reported by Platform PM (Section 2.5.1). PlatPM considers it helpful when AppDev is a good dependent. The data indicates that the Platform PMs view the relationship to be one where it is helpful when the dependent makes the compromises and accommodates their preferred method of work. Contrasted with the behaviours that AppPM and AppDev find Helpful, the behaviour is an example of an underlying characteristic of asymmetric interdependence (differences in expectations, Section 2.6.3).

2.6 Analysis: Characteristics of Asymmetric Interdependence

The previous data was presented as evidence to argue that there was a significant and task-related asymmetric interdependence between the Application and Platform groups. The data indicates that the manner in which the two teams were split introduced a heavy dependence between the two teams; Application was designed to depend on the Platform team's work, and the Platform team was designed to be independent from the Application team. The results of the qualitative analysis will be drawn on to present three arguments: 1) the Application and Platform groups perceive their interaction differently; 2) the Application and Platform groups have different priorities and prioritize requests from the other group differently; and 3) the Application and Platform group have different expectations as to what constitutes helpful or proper behaviour from the other group. The data will be used to argue that these differences are due, at least in part, to the asymmetric interdependence that was set up by the Company, in order to conform to standard and accepted software engineering practices. Setting the two groups into a situation in which one is dependent on the other, yet the other is not dependent in any task-related way on the first, creates an asymmetry which may cause a difference in perceptions, priorities and expectations. The following three sections will present the argument and the evidence drawn from the analysis in Section 2.5.

2.6.1 Perceptions are different

A group's perceptions refers to the overall number of helpful and unhelpful behaviours behaviours reported by all individuals in that group. The total helpful and unhelpful behaviours give a clear and simple high-level summary of how each group perceives the other. Information is unavoidably lost when summing helpful and unhelpful behaviours, however a group's perceptions are an overall indication of how well the relationship is working from their point of view. Differences would indicate a lopsided experience of the interaction.

When behaviours are summed a clear picture of the difference in perceptions between the groups emerges. Figure 2.2 displays the percentage breakdown of helpful and unhelpful behaviours as reported by each group. The Application group perceives far more unhelpful behaviours (83%) than helpful behaviours (17%), compared to the Platform group which perceives a more balanced number of unhelpful (47%) and helpful (53%) behaviours.

A link-by-link breakdown of the overall differences in perceptions provides a more detailed view of how the groups perceive each other (Figure 2.3). The AppPM's perception of the AppPM–PlatPM link is particularly negative with only 11% helpful behaviours and 89% unhelpful. The AppDev's perception of the AppDev–PlatPM link is slightly more balanced with 36% helpful behaviours and 64% unhelpful. Compared to the Platform group's

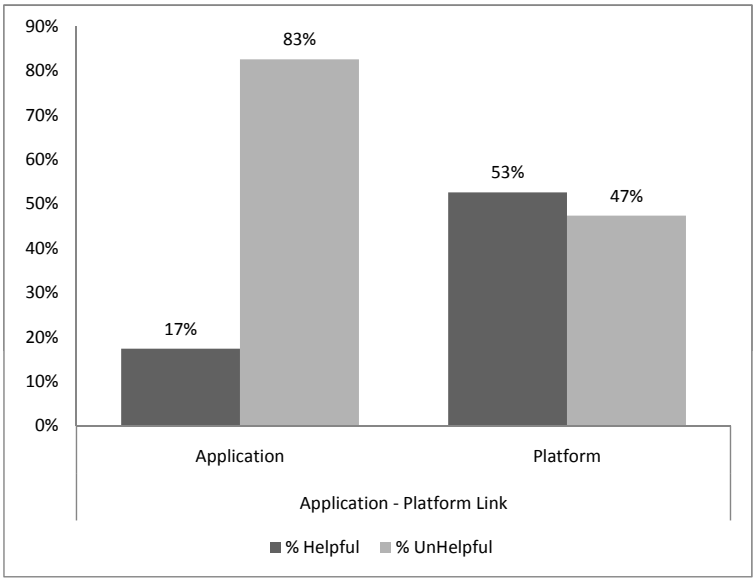


Figure 2.2: Percent of behaviours reported to be helpful vs. unhelpful by group

perceptions of the exact same interaction: PlatPM's perceive their interaction with AppPM to be relatively balanced with 53% helpful beahviours and 47% unhelpful, and view their interaction with AppDev's as balanced with 50% helpful and 50% behaviours. Although it should be noted that the sample size for the PlatPM's perceptions is smaller than the AppPM's (3 PlatPM's interviewed vs. 6 AppPM's), and almost insignificantly small for the AppDev–AppPM interaction (1 PlatPM interviews vs. 2 AppDev's). This was an unavoidable consequence of this study being a reanalysis of data collected for an previous unrelated study (see Section 2.4.1).

The overall difference in perception help to quantify the qualitative findings presented in the results section above. Application PMs and Devs reported that Platform PMs and Devs don't realize that what they do has such a great effect. To be clear, Application does affect Platform's higher level outcomes; if an Application feature crew is late on a feature it would affect the entire product group's ability to complete their product in time. Such a feedback would occur at the end of the product development timeline, which lasts one year. There are many ways in which the delay from an Application feature can be absorbed before it leads to a delay in the entire project, and thus impact Platform. A Platform feature crew, on the other hand, need only be late one day before it impacts an Application team. Such a delay directly affects an Application team because they depend on Platform's output directly. An AppPM summarizes the the problem:

> I feel like they lose sight of the fact on how much they affect us. So I think that it's quite clear that we're dependent on what they're building, but I think they

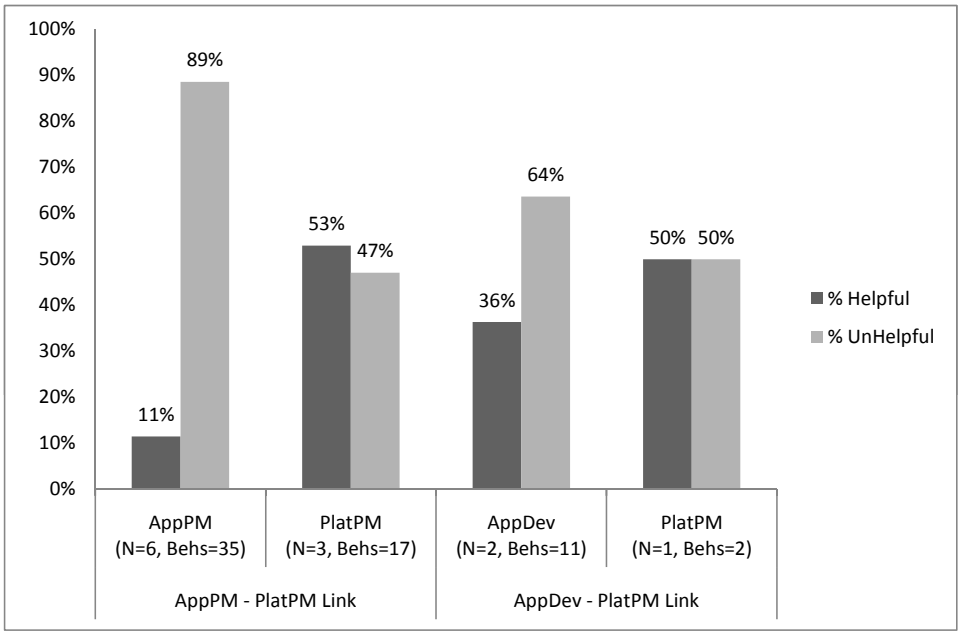


Figure 2.3: Percent of behaviours reported to be helpful vs. unhelpful by link

> forget that we're as dependent on it as we are... They think it's no big deal on our side, when in fact is is a big deal, from a resource and timing perspective. [AppPM6]

Previous research on the effects of asymmetry on trust have proposed that as dependence increases, so does power. de Jong et al. (2007) cite Rusbult and Van Lange (2003): "the concepts of dependence and power are inextricably related, in that to the extent that one person (A) is relatively more dependent, the other (B) is relatively more powerful" (p. 355). de Jong et al. (2007) use work from psychology on power and attention to argue that "power disadvantages tend to focus the attention of the less powerful individual on the behavior of the more powerful individual" (p. 1627). In contrast, "people in power . . . do not need to pay attention, . . . and they may not be personally motivated to pay attention" (Fiske 1993, p. 621). There is no explanation given for the difference in attention.

Whether or not it is true that Platform has power over Application, Application appears to be more closely attuned to the behaviours of Platform. This may simply be because Platform's behaviour has such an impact on Application's ability to complete their task. It also appears from the data that Application perceives far more negative behaviours than positive from Platform. The finding may be an artifact of recall, that behaviours that constrain a task are easier to pinpoint and remember, and behaviours that lift constraints or allow a task to continue are assumed to be part of the ways things should be. It could also be an example of a broader "theme" of asymmetric interdependencies which Agar (1980) found in a study

of interpersonal relationships: informants in a subordinate position expressed more negative affect toward the dominant member (p. 40). I believe the first is more plausible in the work situation studied.

In summary, it appears that the Application group perceives their relationship to be far more unhelpful than the Platform group. This perception is at least partly due to the way in which the two groups have been designed to work together: Platform was designed to be the foundation on which Application builds its products. According to proper software engineering guidelines, and accepted rules of design, Platform's code affected Application, but Application's code did not affect Platform. An asymmetric interdependence was set up which caused Application to perceive the behaviours of Platform differently; Application PMs and Devs focused their attention on unhelpful things that Platform had done to them in the past.

2.6.2 Priorities are different

Software engineers in the Application group believed that the amount of work an employee could complete was a finite resource. In order to get someone to do what you wanted them to do, you needed to move that work item higher on their priority list. If an Application PM was able to move a work item higher on a Platform PM or Dev's list, they had done their job well. If an AppPM could not move an item higher on the list, they tended to attribute the problem to a difference in priorities. An Application Program Manager explains the importance:

> It's a question of priorities. It always comes down to priorities. You can move the earth if you prioritize it high enough, that's why in WWII they made the atom bomb in two years. The single most important thing that I do is prioritize — I help my team, my partners, etc. [AppPM3]

The data suggests that the Application group attributed a number of behaviours directly to a difference in priorities, whereas the Platform group mentioned behaviours that only tangentially related to priorities. The most substantial unhelpful behaviour reported by AppPM was, "*Our critical dependency was not seen as a priority by them*," reported 10 times by five different AppPMs. An AppPM explained one particular instance:

> The person in charge of specifying the feature, he was a contractor who has left for six months. So, it seems like if I was going to develop a feature that a bunch of other people would rely on — or if I was a manager and I was looking at all

> the people to assign to a feature, I would definitely not assign the feature that everyone relied on to the person who was going to leave. [AppPM2]

The second most important unhelpful behaviour reported by AppPMs was, "*It is difficult to get PlatPM to do what we need them to do*," which was reported eight times by all six AppPMs. An AppPM explains a specific difficulty:

> You have to present a very strong case and it's always difficult when you say, 'Hey, you guys should do this. It would make our job a lot easier.' It's just—it's a difficult ask unless you can say, 'Well, this is how it benefits you.' [AppPM4]

The unhelpful behaviours, "*Hot Potato features*," and "*They don't communicate well with us about our dependencies*," were the third and forth most important unhelpful behaviours reported by AppPMs (reported seven times by three AppPMs, and six times by two AppPMs, respectively). These behaviours also relate to priorities from the AppPM's point of view: "hot potato features" are a failure of the Platform group to assign a high priority to features that the Application group value, and a failure to "communicate well about our dependencies" indicates that the Platform group does not think these dependencies are as vital as the Application group thinks they are.

From the Platform group's point of view, one unhelpful behaviour was related to priorities, "*It's tough to balance my needs with theirs*," which was reported once by one PlatPM. This PM realized that the Application group's needs were conflicting with their needs, and they had to find a place on their priority list that would balance the two.

The data indicates that the Application group focuses heavily on Application priorities while the Platform group does not. This is understandable, in that the Platform group is concerned with their own work first. But wouldn't the Platform group be concerned with Application group's priorities, given that the Application group was building the end product, the part of the Internet Product Group's (IPG) system that the customer interacted with? To understand the dynamic we need to examine how the two groups viewed each other and each other's place within the IPG.

Application viewed themselves as the end result of the entire Internet Product Group. It was the Application's work that determined the look of the Internet Product, the product's feel, and the product's functions. Platform was viewed as the underlying tools that Application was employing to provide the service to the customers.

Platform viewed themselves as the foundation for the Application's product. They also viewed themselves as creating a robust, scalable, and extensible foundation that other teams

would soon be using to build products upon. At the end of the study I was able to interview one member of a new group that had recently begun to use Platform's code. Platform had started to interact with two application groups, further solidifying their view that they were the foundation which other groups used to build upon.

From a naive point of view, it would seem that Platform should depend on Application. After all, it is Application's product that would ultimately make or break the Internet Product Group; Platform was only the foundation upon which IPG's customer-facing product was built. From a software engineering point of view, the relationship that emerged was inevitable. While Platform does depend on Application's success in an overall sense, in their day to day task-related interactions Application depends on Platform. It was the principles of software engineering that placed Application as the dependent of Platform, so that Platform could isolate themselves from changes from the Application group. This relationship was ideal from a software engineering point of view but it may have helped create the the situation highlighted by the difference in priorities: Platform did not view Application's priorities as their own priorities, and as a result Application found it difficult to get their day-by-day tasks completed.

2.6.3 Expectations are different

Perhaps the most telling result of the asymmetry between Application and Platform is the difference in what they expect the other to do. Many of the helpful or unhelpful behaviours reported by the interview subjects can be interpreted as a request for the other group to do or to not do something. The following sections will examine those behaviours from each group's POV.

AppPM's expectations of PlatPM

All seven behaviour categories reported by AppPM, both helpful and unhelpful, could be classified as a request or desire for PlatPMs to "do something." The helpful behaviours are straightforward: "*Responsive to my emails about my dependencies,*" "*It's easier to get what we need from Platform compared to external teams*," and "*Status meetings are helpful, but I only go when I need something,*" are all examples of situations in which the AppPM needed something from the AppPM (email updates, agreements on work to be completed, agreements on work during face-to-face status meetings).

The unhelpful behaviours are similarly straightforward: "*Our critical dependency was not seen as a priority by them*," "*It is difficult to get PlatPM to do what we need them to do,*" "*Hot*

Potato features," and "*They don't communicate well with us about our dependencies*," are examples where AppPM needed something done but it wasn't (an issue regarding a critical dependency wasn't handled quickly enough, a request for work was ignored, features we needed them to complete were bounced around because they didn't care about them, and they didn't give us timely communication).

These helpful and unhelpful behaviours from the AppPM's point of view relate to ways in which the Platform group did or did not do something for them. Every example the Application interviewees gave was related to an action that the Platform group either did or did not do.

PlatPM's expectations of AppPM

From the Platform PM's point of view, two helpful behaviours and two unhelpful AppPM behaviours could be classified as a request to "do something." The two helpful behaviours, "*They follow up to remind me of their dependency*," and "*Their requirements are clear and formal*," are self-explanatory examples of when the AppPM did something helpful for the PlatPM. The unhelpful behaviours, "*They have trouble conforming to my scenarios,*" and "*Sometimes they don't show up to status meetings, so we can't help them out*," are examples of things that the AppPM did or didn't do (AppPM didn't do what our formal "scenarios" specified, and AppPM didn't show up to our meetings).

In contrast, there are five helpful and unhelpful AppPM behaviours that could be classified as requests to "refrain from doing something." The helpful behaviours, "*They accommodate our needs by cutting their functionality*," and "*They don't escalate unnecessarily*," are examples where PlatPM wanted AppPM to stop or refrain from doing something (they stopped asking for more functionality, they refrained from turning to upper management to solve intergroup problems). The unhelpful behaviours, "*Maintaining communication is difficult (I have too many dependencies)*," "*They changed their requirements*," and "*It's tough to balance my needs with theirs*," are examples where PlatPMs wished that AppPM would stop doing what they find unhelpful (stop so many dependents communicating so frequently, stop changing your requirements, stop making so many requests which cause me to balance my workload).

From this relatively small sample of the interactions it appears that the Application group is in a position where they want (or even need) Platform to do things for them. Seven out of seven of the behaviour categories reported by the AppPMs can be classified as "do something" or "they did not do something" for their group. In comparison, the Platform group is in a position where they both want Application to do things for them as well as *refrain* from doing things. Four out of ten categories reported by the PlatPMs can be classified as "do something," while five out of ten categories can be classified as "refrain from doing something."

Asking a group to refrain from a particular behaviour illustrates the asymmetry between the groups. That every one of Application's behaviours were related to Platform doing something for them highlights the extent to which they depended on Platform's behaviours to get their work done. That Platform needed Application to stop doing things, such as stop asking for features, and stop communicating, demonstrates the position of control that Platform had. Platform needed very little from the Application group. Some of the communications that came from Application took on a sense of annoyance and distraction. In summary, the asymmetry between the groups may have contributed to a difference in how each expected the other to behave. Application was the dependent, as required by the software engineering principles that guided the separation and interaction of the group's work. Platform desired Application to act accordingly.

2.7 Implications

This study used interview data to argue that two teams, arranged in an asymmetric interdependency, developed different perceptions of their interactions, different priorities, and different expectations for the behaviour of the other group. In a case study it is impossible to prove a direct causal link between the one-way dependency and the behaviours reported by the interviewees. But I would argue, based on the evidence presented, that the structure of the interdependency at least influenced their behaviour, perceptions and expectations.

Qualitative case studies often leave the researcher with more questions than answers, and this is no exception. Does a one-way dependency influence the behaviours of the two groups involved? Does the one who is depended upon "hold all the cards" in their interaction? Can they dictate terms and act as if they are in control? Does the dependent understand this interaction and act differently towards the other? Does asymmetric dependence in a task-related relationship produce the same dynamic as a power imbalance does in an interpersonal social relationship (Rusbult and Van Lange 2003)?

One-way asymmetric interdependencies are better understood in the social psychological literature on interpersonal relationships than in the management literature. To what extent do the theories of that area transfer to situations in which the people and groups are task-related? The difference may be significant, because in a task-related interaction there are many constraints that act on workers that are not present in interpersonal relationships (such as performance measurements, group and sub group goals, the task goals themselves that define a work relationship, and so forth).

As a result of this case some basic questions emerge. While many other questions may be inspired by the case study, the following three questions are particularly interesting be-

cause together they investigate a very simple issue that has not been adequately addressed in the literature: the influence of a work team's structure on the helping behaviour within that work team. First, does level of dependence effect the number of helpful behaviours between coworkers? Does current literature predict greater or fewer helpful behaviours in situations of high dependence versus situations of low dependence? Secondly, does the structure of dependence affect the number of helpful behaviours between coworkers? Does current literature predict greater or fewer helpful behaviours in situations of asymmetric (one-way) dependence versus situations of symmetric (two-way) dependence? And finally, although the case study did not indicate that performance rewards affected behaviour in a significant way, the literature has consistently investigated performance rewards in concert with interdependence. This influenced the third question: does group versus individual performance rewards influence the number of helpful behaviours between coworkers? And if so, can performance rewards be used to soften any negative effects of the physical structure of the coworker's dependence? The remainder of the dissertation will discuss and investigate these questions.

Chapter 3

The effect of interdependence on behaviour

The case study in Chapter 2 described a situation in which a software group named Application was heavily dependent on a group named Platform. The data indicated that Application perceived Platform to be very unhelpful, yet Platform perceived their relationship to be balanced. Due to the nature of case study data there could be many reasons for the unhelpfulness and conflict perceived by Application. Were Platform's unhelpful behaviours a result of personal dispositions, attitudes, or idiosyncratic interpersonal issues? Or were these difference due to the task-relationship Application and Platform were placed in? Application was *designed* to be asymmetrically dependent on Platform. To what extent did this structural dependence cause the behaviours and perceptions recorded in the case study?

This chapter investigates the effect that interdependence has on behaviour. If it is true that asymmetric dependence is one of the causes for the differences in helping behaviours observed in the case study, then how do researchers understand the effects of asymmetric dependence? Has interdependence itself been found to affect the extent of helping behaviour? Perhaps most importantly, *why* and under what conditions would someone help another if they were not likewise dependent on that person?

3.1 Understanding interdependence

How one worker's job affects another's is fundamental to the study of organizations. It is the question of how one worker's task impacts another's task, and how one worker's action and non-action affects another's ability to complete their work. It is an issue that is at the heart of how work is designed, but it has been often neglected by work design theories (Grant and Parker 2009, p. 323). Only recently have scholars argued for a refocused effort on studying how work relationships themselves affect work outcomes (Morgeson and Humphrey 2006).

This has been called the relational perspective of job design (Grant 2007). First I will briefly discuss the genesis of scholarly interest in the social and task interconnectedness of work.

3.1.1 Interdependence as the foundation of organization theory

One of the original discoveries linking task-related relationships to productivity came from a pin factory. In 1776, Adam Smith discovered that 10 workers could produce no more than 200 pins a day if each worked on their own set of pins (Smith 1966). He found that manufacturing a pin could be divided into separate tasks such as straightening, cutting, sharpening, grinding, and painting. If each worker specialized in a task, the group of 10 could produce as many as 48,000 pins per day. This discovery, referred to as the division of labour, was and is the cornerstone of theories of work. Years later, Frederick Taylor developed Scientific Management, a rigourous application of division of labour. Rigourous to such an extent that the workers themselves were argued to be physically and mentally predisposed to a narrowly defined job (Taylor 1911). Even the human relations movement, which was sparked by the Hawthorne Studies (Mayo 1933), and explicitly challenged the Scientific Management orthodoxy, found that the division of labour affected power, social influence, and worker behaviour. The Relay Assembly Test Room demonstrated that a person (in this case a researcher), who was placed originally as an observer, took on the role of a supervisor, and through their interactions helped increase the room's productivity by 30 percent. The Bank Wiring Observation Room studies demonstrated that the task relationships between the front and back groups may have contributed to a difference in power, and may have helped create social pressures on workers to conform to group norms (Rollinson 2005, pp. 11-12). These early insights highlighted the influence that the division of labour had over the productivity and social behaviour of workers. It was only later that scholars tried to better describe and understand how workers affected each others' tasks.

Simon (1957) recognized that interdependencies arose when one worker's ability to complete their task depended on another worker's behaviour. In order for two interdependent workers to successfully complete their tasks they needed to coordinate their actions. Coordination, then, is informing each participant as to the planned behaviour of the others (Simon 1957, p. 72). Coordination results when the behaviour of the individual is guided by his expectations of the behaviour of the other members of the group (p. 124). Above and beyond ensuring that the behaviour of others is predictable and in the right direction, Simon argued that coordination ensures that members of the group have the same goal (p. 139). Simon argued that coordination could occur through two main mechanisms. First, *self coordination*, whereby an individual coordinates their actions with the activities of others through simple observation of what they are doing. Self coordination does not need explicit communica-

tion, it can operate with observation and self-adjustment. More effective self coordination requires others to communicate their intentions. Second, *more complicated forms of coordination*, which require at least three steps: 1) the development of a plan of behaviour for all the members of the group; 2) the communication of the relevant portions of this plan to each member; and 3) a willingness on the part of the individual members to permit their behaviour to be guided by the plan (pp. 103-108).

Later, March and Simon (1958) defined interdependence as a "felt need for joint decision-making," (pp. 121-123). Joint decision-making could be accomplished using mechanisms designed to handle different levels of routine. Highly routine situations could be handled through decisions made ahead of time, called Simple Programming, which are rules governing organizational action given certain conditions. Less routine through Coordination by Plan, which are preestablished schedules of behaviour. Non-routine situations could be handled through Coordination by Feedback, which is transmission of new information to handle contingencies not anticipated in the schedule (p. 162). The focus again was on the coordination mechanisms through which the interdependencies could be handled.

It was not until Thompson (1967) that interdependence was considered by itself as a determining factor in organizational structure. Interdependence was defined as, "The extent to which a task requires organizational units to engage in work flow exchanges of products, information, and/or resources and where actions in one unit affect the actions and work outcomes in another unit" (p. 54).

Thompson developed what he called a "Guttman-type scale" (p. 55) of interdependence, where each incrementally more complex form of interdependence contains all less complex forms. The simplest form of interdependence is pooled, where one unit[1] depends on another unit not in any direct way, but they depend on each other through the higher level unit to which they both belong, in the sense that if one unit fails it jeopardizes the higher level unit. Thompson describes this situation as one in which "each part renders a discrete contribution to the whole and each is supported by the whole" (p. 54). Pooled interdependence has also been used by later writers to describe the interdependence between units who depend on a common resource[2], although this is not precisely what Thompson meant by the term. The second most complex form of interdependence is sequential, in which a first and second unit can be identified to make contributions to and depend upon the higher level organization, so that there is a pooled interdependence between them. But also a direct interdependence can be identified between them, such that the first unit needs to act properly before the second can act, and unless the first acts the second cannot solve its output problem (p. 54). The third and most complex interdependence is reciprocal, in which two units both support and

[1] In Thompson's terms, unit is used to refer to an individual, group, department, or even company.

[2] Malone and Crowston (1994) used the term "shared resources" (p. 91).

are supported by the larger organization (pooled), and the second unit depends directly on the proper actions of the first in order to solve its output problem (sequential), but where the first unit then depends further on the successful actions of the second unit. The outputs of each become the inputs of the other, such as in an airline which contains both operations and maintenance units (p. 55).

Each increased level of interdependence requires a increased level of complex coordination, which correspond closely to those suggested by March and Simon (1958). Under some conditions, pooled interdependence can be coordinated through standardization (simple programming), sequential interdependence through coordination by plan, and reciprocal through mutual adjustment. Each level of complexity places an increasingly heavy burden on communication and decision, with standardization requiring the fewest decisions and least frequent communications, and mutual adjustment requiring the most decision and communication activity. "There are very real costs involved in coordination" (Thompson 1967, p. 56). Thompson further proposed that organization design decisions result from trying to minimize coordination costs. Organizational structure such as departmentalization (p. 57) and hierarchy (p. 59) are consequences of such decisions. Thus, Thompson showed that having a clear understanding of interdependence is an important aspect of studying how organizational structure evolves and changes.

Perhaps Mintzberg summarized it best when he said, "The two fundamental and opposing requirements of organized human activity are the *division* of labor into various tasks to be performed and the *coordination* of these tasks to accomplish the activity" (Mintzberg 1979, pg. 2).

3.1.2 The influence of sociotechnical systems research

Sociotechnical systems theory, upon which job design theory was built, was very much aware of the influence of interdependence on work outcomes. Kiggundu (1981) summarized the extent to which interdependence was found to affect a workers' ability to complete their tasks:

> These studies followed the introduction of the mechanized longwall method of coal getting and examined its effects on the organization of work and the responses of various groups of employees. They found that the three shifts making up the 24-hour operations were highly interdependent. For example, the work performance of the first shift (cutting) significantly affected the nature and success of the second shift (ripping), which in turn affected that of the third shift (filling). They also found that the various occupational tasks making up

> each shift were also interdependent. For example, the first shift, which prepared coalfaces for firing shots, was responsible for three tasks: boring holes for the short-firer, driving the coal-cutter, and firing the shots. These tasks, done strictly in this sequence, were highly interdependent. If holes were not bored through to the full depth of the undercut, the shots fired would be less effective. Cutters producing uneven cuts would create reduced work heights and affect the productivity of the fillers. Likewise, poor workmanship by the gummers would make the work of the firer less effective. Other functions of the production process were also highly interdependent. These findings led Trist and Bamforth to remark that "so close is the task interdependence that the system becomes vulnerable from its needs for one hundred percent performance at each step" (1951, p. 18) (p. 500).

Kiggundu (1981) built on the findings of sociotechnical theorists by proposing that interdependence could be differentiated into initiated task interdependence and received task interdependence, and that each has a different effect on an worker's felt responsibility for their own task and for their dependent's tasks. Initiated task interdependence occurs when work flows from the initiator to one or more receivers, such that the successful performance of the receiver's job depends on the initiator's. Received task interdependence occurs when a person's performance of their job depends on the work flow from one or more other jobs. Kiggundu (1981) proposed that each form of interdependence has three elements: scope, which is "the breadth of interconnectedness of a a particular job with other jobs" (p. 501); resources, which is "the degree to which the interdependence between two or more jobs involves receiving or giving resources necessary to do the job" (p. 501); and criticality, which is "the extent to which the interdependence between the focal job and one or more other jobs is crucial for the performance of the focal job" (pp. 501-502).

The proposed effect of initiated task interdependence is supported by Thomas (1957) and Horsfall and Arensberg (1966) who found that when workers facilitate the work of others, they experience a sense of responsibility, possibly because they realize that others depend on them in order to complete their task and to receive performance-related rewards. Kiggundu (1981) proposed that initiated task interdependence would be positively related to experienced responsibility for their dependent's work. The effect of received task interdependence is supported by sociotechnical systems theorists. Trist and Bamforth (1951) found that miners occupying roles high in received task interdependence 1) refused to accept responsibility for production, 2) developed norms of low productivity, 3) did not utilize their full potential, and 4) engaged in "self-compensatory" absenteeism and turnover more than others. Further, roles high in received task interdependence spent more time in nonproductive activities

(Kiggundu 1983, p. 150). Kiggundu proposed that received task interdependence would be negatively related to employee's valued personal and work outcomes: work motivation, work satisfaction, growth satisfaction and performance.

The findings were partially supportive of Kiggundu's model. Initiated task interdependence was positively related to the employee's felt responsibility for their dependent's outcomes, as well as for the employee's valued personal and work outcomes. On the other hand, the expected negative relationship between received interdependence and valued outcomes was not found; the correlations were practically zero. Possible explanations included a relatively high correlation between initiated and received task interdependence (.50) which indicated a lack of discrimination between the two scales. The results of the scale subdimensions for each form of interdependence (scope, resources, and criticality) were inconclusive.

3.1.3 Defining interdependence

Asking a scholar to define interdependence would serve as an excellent Rorschach test—there are almost as many definitions for the concept as there are papers written about it. I will argue that most definitions differ only in the language used.

Staudenmayer (1997) states that there is a "confusing multitude of conceptualizations and operationalizations" leading to a "high degree of ambiguity and confounding with respect to the concept of interdependency," which reflects "fundamentally different assumptions about the nature of technology, organizations, and people" (pp. 2-3). While the number of different definitions are as great as the number of papers dealing with interdependency, the situation is not as bad as it seems. Certainly differences exist in the wording used, for example, "the degree to which an individual's task performance depends upon the efforts or skills of others" (Wageman and Baker 1997, p. 141), compared to "the extent to which an individual team member needs information, materials, and support from other team members to be able to carry out his or her job" (Van der Vegt et al. 2003, p. 717). But most definitions are a rewording for only minimal benefit over Thompson's original: "The extent to which a task requires organizational units to engage in work flow exchanges of products, information, and/or resources and where actions in one unit affect the actions and work outcomes in another unit" Thompson (1967, p.54).

There is a small amount of controversy over what Thompson meant with his view of interdependence. Some authors content that his interdependence only referred to organizational units, from work teams and higher, to the level of physically separate offices and departments (Wageman 2001, p. 199). Thompson's interdependencies are argued to be pre-identifiable, stable, clearly visible, and a simple result of the technology used in the task (Staudenmayer

1997, p. 6, 13), and are "not a structural feature that can be manipulated" (Stewart and Barrick (2000, p. 138), referring to Van de Ven and Ferry (1980)). However, Thompson did not mention these caveats. There is nothing inherent in the concept that would prevent Thompson's interdependence to refer to intra-group processes, or to interdependencies that occur and disappear spontaneously and unpredictably (e.g., Saavedra et al. 1993, pp. 62–63).

Staudenmayer (1997) proposes that the terminological confusion stems from a disagreement about the underlying, and implicit, theoretical perspective employed by each writer. She argues that there are three competing theoretical perspectives: information processing theories, resource-based theories, and sense-making theories.

Sense-making theories suggest that interdependencies between workers are so complex, seemingly random and unpredictable, that those workers have only a limited ability to understand and reason about the structure of their work (Weick 1990; Staudenmayer 1997, p. 29). Sense-making theorists argue that an organization's interdependencies and coordination cannot be planned with conscious reflection of its members and managers, but are instead unconsciously arrived at through adaptation to local task demands (Hutchins 1991), or subtly influenced through changes in the physical arrangement of tools and work stations (Hutchins 1990). Other theorists argue that interdependencies, complex and ill-understood, are best coordinated through "heed," defined as "a disposition to act with attentiveness, alertness, and care" (Weick and Roberts 1993). Although intriguing and intuitively appealing (interdependencies *are* often difficult to pinpoint and analyze) the sense-making perspective will not be incorporated into this dissertation. The theories are not designed to increase understanding of a specific instance of interdependence between two units, or offer analytic solutions to predict the impact that this interdependence would have on the behaviour of the units involved.

Staudenmayer's remaining two competing theoretical perspectives, information processing theories and resource-based theories, are practically the same approach. The information processing perspective is exemplified by Thompson (1967) and Galbraith (1977), while Malone and Crowston (1994) and Salancik and Pfeffer (1974). Earlier I noted that Malone and Crowston (1994) built on Thompson's categorization of interdependencies, and there is little difference in their conceptualization of interdependency. Indeed, Malone and Crowston take Thompson's coordination mechanisms and extend them, adding a number of refinements and terminology from engineering and computing systems. Similarly, it is difficult to see how interdependence as discussed by Salancik and Pfeffer (1974) differs from Thompson's original concepts of interdependence, except that the authors are speaking of resources instead of information. Indeed, Thompson (1967) argued that resources are one of the three things for which units would depend upon each other (the other two being products and information). Though the recognition that interdependence is inextricably tied to power was

a substantial contribution, which is addressed in Section 3.3.7.

Staudenmayer (1997) argued that the terminological confusion surrounding the definition of interdependence stemmed from a disagreement about the underlying theoretical perspective taken by the researchers. I have argued that the perspectives are not substantially different in the case of information theory and resource-based perspectives. In the case of sense-making theories, the perspective is not useful for the present topic. In other words, I believe the definitions of interdependence are different in terms of wording, not in substance. When needed, I will adopt the Thompson (1967) definition of interdependence.

3.1.4 Task interdependence vs. reward interdependence

The distinction between task and reward interdependence is more important than the disagreements between definitions of task interdependence. Task and reward interdependence are forms of interdependence, both of which can be distinguished in field studies and experiments, and have been shown to influence behaviour in different ways (Johnson and Johnson 1989; Saavedra et al. 1993).

Reward interdependence is the extent to which the rewards one individual receives are linked to the task performance of others. Practically speaking, reward interdependence depends on the performance measurement used, which typically varies on one dimension between individual and group. If reward interdependence is high, one person's rewards depend on the task performance of others, and this is usually created with a group performance measurement. For example, a person works at a call centre with 40 other people and their reward is based on how many calls the entire group processed. If reward interdependence is low, one person's rewards do not depend on the task performance of others, and this is usually created with a purely individual performance measurement. For example, a person works as a member of a product marketing team and their reward is based only on how many pages they individually contributed to the final report. In practice, performance measurements are often a combination of individual and group reward, and a very high-level concept of group may be used, such as an organization in the case of employee stock reward plans. The rules for which combination leads to which level of reward interdependence have not been formalized, although the term "hybrid" has been used to describe a middle level of reward interdependence (Wageman 1995, 2001).

There are, of course, practical issues that muddy the clean separation between individual and group performance measurement. The examples given above hint at the issues. It is usually possible to have a group performance measurement regardless the type of interdependence. In the call centre example, even though the person does not require any information,

resources, or products from the other call centre employees, and even though the actions of the call centre employees (within reason) do not affect their ability to complete their task, the person is still rewarded based on the entire group's performance. This is plausible and not difficult to put in place, although fairness is another matter. The marketing team example is a little more implausible. For a situation where a team is working together on a common project, with resources, information, and the products of action being passed among each other in frequent and ad hoc reciprocal interdependencies, is it even possible for an evaluator to determine any one individual's contribution to the final product? If it is possible, would it be fair to the others who were equally important but did work that did not appear as part of the finished products materials (e.g., a researcher)? However, while the different forms of performance measurement may be impractical, they are still conceptually distinct and useful for describing the interdependence between workers.

A second issue is the separation between task interdependence and reward interdependence; they are not mutually exclusive concepts. The amount of task interdependence may affect the amount of reward interdependence, but not vise versa. As task interdependence increases, the ability to complete one's task increasingly depends on the ability of others to complete their tasks. Even if a purely individual performance measurement were practically possible, the other's task performance will affect one's own task performance, which will affect one's own performance measurement and reward. Therefore, as task interdependence increases, so would reward interdependence. The degree to which reward interdependence increases would depend upon the extent to which the other were able to affect one's ability to receive one's reward. The opposite is not the case, however. As reward interdependence varies in either direction, the amount of task interdependence would remain the same. This is because rewards do not directly affect the interdependency required by the task. In the call centre example, moving from an individual to group performance measurement would certainly affect one's ability to receive rewards, but it would not affect the task of answering calls. Nor would changing from an individual to a group performance measurement affect the marketing team member's task of research, writing, or deciding. This is not to say that reward interdependence would not affect behaviour, which it has been shown to do quite reliably by changing the situation to cooperative or competitive (Deutsch 1949; Johnson and Johnson 1989; Stanne et al. 1999).

At this point a clarification is needed between reward, outcome, and goal interdependence. Reward interdependence is frequently confused with something different: outcome interdependence (which is sometimes also called goal interdependence). Outcome or goal interdependence refers to the extent to which an individual's ability to reach their goal depends on the ability of others to reach their goal. Confusingly, goal interdependence is very similar to task interdependence, if it is assumed that in order to reach their goal, an individual would

need to complete their task. On the other hand, if their goal is rewards, then wouldn't goal interdependence be the same as reward interdependence? So is goal interdependence task interdependence, or is it reward interdependence? That, of course, would depend on what the individual's goal is. To increase the confusion, goal interdependence could equate to reward interdependence through a type of "evaluation interdependence;" where since the goal of the employee is to complete their task successfully, and they are being evaluated based on their ability to complete their task, goal interdependence could imply evaluation (and therefore reward) interdependence. In order to remove this confusion, the term task interdependence will be used instead of outcome or goal interdependence, which has caused problems in the past (e.g., Wageman 2001, p. 201). Only the term "reward interdependence" will be used to refer to rewards; the terms "goal" and "outcome interdependence" will be avoided.

3.1.5 Level of dependence vs. mutuality of dependence

With three exceptions, when writers speak of extent of interdependence, or amount of interdependence they are speaking of situations in which person A and person B are mutually dependent upon one another. "The studies that have been carried out have all examined the relationship between symmetrical task dependence and the extent to which team members help each other (e.g., Anderson and Williams 1996)" (de Jong et al. 2007, p. 1626). When researchers measure low and high interdependence in the field (e.g., Pearce and Gregersen 1991), or when they manipulate amount of interdependence in an experiment (e.g., Wageman 1995; Allen et al. 2003), they are varying the extent to which team members depend *on one another*. But studies have demonstrated that dependence can be asymmetric; group members can receive work from another member and never be in the position to give work back (Trist and Bamforth 1951; Saavedra et al. 1993), and an individual A can identify a coworker B who they depend heavily upon, but understand that B does not likewise depend on them (de Jong et al. 2007). The case study in Chapter 2 illustrated such a situation between software teams. In order to better understand interdependence it is useful to separate the concept into two components: level and mutuality.

Level of dependence refers to the extent to which one person depends on another to complete their task. This can vary in degree and in field studies is typically represented on a scale from none to very high (e.g., Van der Vegt and Jannsen 2003, p. 736). The concepts of scope, resources and criticality Kiggundu (1981, pp. 501–502) collectively refer to level of dependence. But perhaps criticality is closest to what is meant by level of dependence. Level involves a notion of timing and correctness; if an action is late it may delay those who are depending on it, the severity of the delay is the level of dependence. Or if an action is incorrect it may force rework or compensatory work, the extent of that extra work is the

level of dependence. Level of dependence captures what was found in the case study and the sociotechnical studies (Trist and Bamforth 1951, p. 18).

Mutuality of dependence refers to the pattern of dependence between coworkers. This can also vary on a continuum from complete asymmetry where B depends on A but A does not depend on B at all, to complete symmetry, where both A and B depend equally on each other's actions. In Thompsonian (1967) terms, asymmetric would correspond to sequential interdependence, and symmetric would correspond to reciprocal. Symmetric also covers the concept of team interdependence (Van de Ven et al. 1976; Saavedra et al. 1993).

Researchers in social psychology have recognized that there is a distinction between level of dependence and mutuality of dependence (Rusbult and Van Lange 2003, p. 355). Indeed,"many extant theories of power ultimately miss the mark, in that they fail to distinguish between level of power and mutuality of power" (Kelley et al. 2003, p. 250). Survey measures have typically not been able to capture a change in mutuality. The most prominent scale, initiated and received task interdependence Kiggundu (1981, 1983) is capable of capturing asymmetric interdependence, but only if both measures are taken with respect to a single other, and analyzed at the dyadic level, which was the approach taken by Bowler and Brass (2006) and de Jong et al. (2007).

For simplicity and clarity this dissertation will consider two levels of level and mutuality: low vs. high, and asymmetric vs. symmetric. Level and mutuality can vary independently as illustrated in Table 3.1. In an asymmetric relationship, A's actions could only minimally affect B's ability to complete their task; if A completed their work poorly, B would still be able to complete their own task, or would only spend a small amount of time on corrections, illustrated as cell (A). Or, A's actions could heavily impact B's ability to complete their task; if A completes their task poorly, B would be unable to complete their task, or B would be forced to spend a great deal of time understanding and/or fixing A's portion before they could complete their own task, illustrated as cell (C). In a symmetric task-relationship, with low dependence, A and B both experience a minimal effect from the other's actions, cell (B). With high dependence, A and B both experience a large effect from the other's actions, cell (D).

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of	Low	(A)	(B)
Dependence	High	(C)	(D)

Table 3.1: Possible combinations of level and mutuality of dependence

For example, in the case study, Application and Platform would rest in cell (C). Appli-

cation depended very heavily on Platform's work and actions (such as prioritization), but Platform had only a minimal dependence on Application's work and actions. Application was forced to redo work, re-prioritize features, take over "hot-potato" features, and otherwise put in extra work due to Platform's actions. If the situation were more symmetric, Platform would experience a similar amount of effect from Application's actions. If there were a lower level of dependence, Application would be able to shrug off Platform's behaviour, work around their unhelpfulness, and would otherwise not feel their impact. The findings from the sociotechnical coal mining studies also describe situations of high dependence and asymmetry (Trist and Bamforth 1951, p. 18).

3.2 Interdependence as an independent variable

Task interdependence has been studied as a component of job design which affects valued work outcomes (e.g., Kiggundu 1981, 1983; Morgeson and Humphrey 2006) and as a task characteristic that affects helping behaviours and performance (e.g., Saavedra et al. 1993; Wageman and Baker 1997; Bachrach et al. 2006b). The following sections will review those studies that have treated interdependence as an independent (causal) variable for various outcomes of interest. The questions guiding this section are, does task interdependence by itself affect outcome variables? The ways in which these studies have explained the effect of interdependence is discussed in Section 3.3.

3.2.1 Effect on valued work outcomes

Morgeson and Humphrey (2006) proposed that social characteristics should be incorporated into the job design literature which had ignored them for too long. Now considered part of the relational perspective of job design (Grant 2007; Grant and Parker 2009), task interdependence is one of the core concepts for describing how workers are related to and affect others, both within and outside their team. Building upon the work of Kiggundu (1981, 1983), Morgeson and Humphrey (2006) incorporated initiated interdependence and received interdependence subscales into the Work Design Questionnaire. The scale for initiated interdependence includes three questions: 1) The job requires me to accomplish my job before others complete their job; 2) Other jobs depend directly on my job; and 3) Unless my job gets done, other jobs cannot be completed. The scale for received interdependence includes three questions: 1) The job activities are greatly affected by the work of other people; 2) The job depends on the work of many different people for its completion; and 3) My job cannot be done unless others do their work (Morgeson and Humphrey 2006, p. 1338).

The valued work outcomes of interest were work motivation, work satisfaction, growth satisfaction and performance. Kiggundu (1983) found that initiated task interdependence was positively related to the valued work outcomes as well as the employee's felt responsibility for their dependent's outcomes. He found no significant relation between received interdependence and any of the valued outcomes or felt responsibility. Slightly contrary to these findings, Wong and Campion (1991) found that as task interdependence increases, the job motivation responds in a $\cap$-shaped manner. They found that jobs with moderate amounts of interdependence had high motivation, and those with low and high interdependence had low motivation. To add further confusion, using a U.S. Department of Labour survey, Morgeson and Humphrey (2006) found no significant correlation between initiated or received interdependence and their outcomes of interest, which were information and communication generalized work activities (although I cannot understand what they mean by these outcome measures).

Incorporating interdependence into their work group characteristics measures, Campion et al. (1993) developed a three item subscale for task interdependence: 1) I cannot accomplish my tasks without information or materials from other members of my team; 2) Other members of my team depend on me for information or materials needed to perform their tasks; and 3) Within my team, jobs performed by team members are related to one another (pp. 848-849). They were interested in how work group characteristics were related to productivity, employee satisfaction, and manager's ratings of employee effectiveness. The authors found that interdependence was related only to productivity. In a replication and extension of their first study, Campion et al. (1996) found a stronger correlation between task interdependence and their outcomes. They concluded that, "interdependence is again found to be an important consideration in predicting the effectiveness of work teams" (p. 447).

In summary, the conclusions from the work design literature are contradictory. Some studies report a monotonic positive relationship between interdependence and positive work outcomes such as motivation, satisfaction, and performance. One study reported a non-monotic $\cap$-shaped relationship, and others have found no relation between interdependence and valued work outcomes.

3.2.2 Effect on performance

A number of survey and experimental studies have investigated the problem of "fit" between a team's type of interdependency either its reward or feedback interdependence. Early studies in goal setting found that adding group-level goals to already present individual goals encouraged higher performance in groups (Matsui et al. 1987). Saavedra et al. (1993) investigated this question further by developing an experiment that paired pooled, sequential,

reciprocal and team interdependencies with individual and group performance feedback.[3] The authors found that reciprocally interdependent teams performed best when matched with group feedback, and that pooled interdependent (essentially independent) teams performed equivalently well when paired with individual feedback. Wageman (1995) found a similar result from a field experiment, but with respect to reward interdependence. Teams working relatively independently performed best when paired with individual rewards, and teams performing with a high level of interdependence performed best when paired with a group rewards. Teams that had a mix (relatively independent workers with a group rewards, highly interdependent teams with an individual rewards, or hybrid teams with elements of low and high interdependence and individual and group rewards) did not perform as well.

The findings from Saavedra et al. (1993) and Wageman (1995) indicate that there is a $\cup$-shaped relationship between interdependence and performance, when matched with the appropriate performance feedback or rewards. Stewart and Barrick (2000) investigated this issue further and found that there was indeed a curvilinear relationship between interdependence and performance, but it changed its shape based on the type of task the group performed instead of the type of reward or feedback. For complex conceptual tasks, low interdependence and high interdependence correlated to high performance, while moderate interdependence was correlated to poorer performance, a $\cup$-shaped relationship. On the other hand, behavioural tasks exhibited a $\cap$-shaped relationship, with low interdependence and high interdependence correlated with low performance, and moderate interdependence correlated with high performance. The curvilinear finding for behavioural tasks was not completely explained, but the result may have to do with the nature of the task and the coordination it required. Teams that perform primarily behavioural tasks, that is tasks defined by "overt, physical behavior, with the execution of manual and psychomotor tasks" McGrath (1984, p. 65), tend not to benefit from increases in team coordination or problem solving. Teams with simple tasks similarly don't require the communication afforded by high interdependence (Gladstein 1984, p. 501), and their performance may even be hurt by the increased coordination overhead (Grant and Parker 2009, p. 331). This is because the teams perform tasks that are easily programmed, and information is centralized instead of distributed among team members (Stewart and Barrick 2000, p. 137).

[3] Team interdependence turned out to be almost equivalent to reciprocal interdependence in the Saavedra et al. (1993) experiment, although it has been argued that they are conceptually distinct (Van de Ven et al. 1976)

3.2.3 Effect on helping behaviour

To what extent does interdependence affect the amount of helpful behaviours between team members? In general, helping behaviours are a type of prosocial organizational behaviour (Brief and Motowidlo 1986) which are affiliative and promotive, and are in-role *or* extra-role (Van Dyne et al. 1995, p. 229). However, scholars have traditionally placed interpersonal helping behaviour under the domain of organizational citizenship behaviour (OCB) as altruistic behaviour (Smith et al. 1983; Organ 1988). Later it was assumed to be an overall second-order construct called helping behaviour, which theoretically included altruism, courtesy, peacekeeping, and cheerleading, because managers had difficulty distinguishing between the subdimensions (Podsakoff et al. 1997, 2009). Other scholars have distinguished between OCBs directed towards and immediately benefitting individuals (OCBI) and OCBs directed towards and benefitting the organization (OCBO) (Williams and Anderson 1991). This has been recognized as a useful distinction because it clarifies the receiver of the behaviour while removing the excess conceptual baggage of the words altruism and compliance (Van Dyne et al. 1995, p. 239). Helping behaviour need not be altruistic, in the sense implied by social psychology, that is, behaviour motivated to increase another person's welfare, often (but not always) self-sacrificing in the absence of obvious, external rewards (Batson 1998, p. 282). The interpersonal helping behaviour, or OCBI category can profitably include the following constructs: Organ's (1988) altruism, the Podsakoff et al. (2009) helping behaviour construct, as well as "Graham's (1989) interpersonal helping, Van Scotter and Motowidlo's (1996) interpersonal facilitation, Farh, Earley, and Lin's (1997) helping coworkers and interpersonal harmony constructs" (Podsakoff et al. 2009, p. 124), and Settoon and Mossholder's (2002) interpersonal citizenship behaviours (ICB).

Katz (1964) remarked that since organizations cannot predict and program for all possible variability, organizational effectiveness and survival requires spontaneous human behaviour both within and outside of role prescriptions (p. 132). Building off his work, a distinction was made in the OCB literature between in-role (required by the job or role) and extra-role (spontaneous behaviour going above and beyond the role requirements) behaviour. OCBs were defined as those behaviours which go above and beyond the call of duty: "individual behaviour that is discretionary, not directly or explicitly recognized by the formal reward system, and that in aggregate promotes the effective functioning of the organization" (Organ 1988, p. 4). OCBs were likened to the grease in the gears of a smooth running organization (Smith et al. 1983, p. 654). Scholars later found that it is extremely difficult to distinguish between in-role and extra-role behaviour, particularly if the behaviour is rewarded or expected in some way by the organization (Morrison 1994; McAllister et al. 2007), or if the employee has personal or social motives for that behaviour (Van Dyne et al. 1995, p. 238). Therefore

I will discuss helping behaviour as a construct which may be labeled by others as PSOB, OCB, OCBI, or ICB, while recognizing that helping behaviour may be considered extra-role in some situations and in-role in others. I will modify the definition used by Anderson and Williams (1996, p. 282) to remove the implication of exchange, and emphasize that helping behaviour not only relates to solving problems but also to furthering the completion of work tasks. Helping behaviour is any action that directly helps/enables supervisors and coworkers to resolve task-related problems or furthers the completion of their task.

Research in helping behaviour is often concerned with the antecedents and consequences of prosocial behaviours (Smith et al. 1983; Organ et al. 2006). This leads many researchers to search for the personal characteristics and the dispositional, attitudinal and behavioural antecedents for helping behaviours (Van Dyne et al. 1995, p.236). For example, in their comprehensive review and analysis, Podsakoff et al. (2000) identified 52 individual, task, organizational and leadership characteristics and behaviours. Of those, only three were task characteristics: task feedback, task routinization, and intrinsically satisfying task. Task and situational factors such as interdependence were not prevalent enough in the literature to be included in the meta-analysis. While employee and leader dispositions, attitudes, demographics, and behaviours have been studied well, I will not discuss these studies as it leads to a vast and deep literature that is not concerned with the interdependence of the work task. Yet, despite this focus on the personal (or perhaps because of it), the core OCB researchers call for a deeper understanding of situational factors such as task interdependence (Podsakoff et al. 2000, p. 531; Organ et al. 2006, p. 113).

The effect of interdependence on helping behaviour has been investigated using field surveys and experimental methods.

Survey studies

Smith et al. (1983) originally hypothesized that symmetric dependence would lead to an increase in helpful behaviours. They argued that interdependence would foster a collective sense of social responsibility (Krebs 1970), and would tend to promote "higher levels of group cohesion than other task environments" (Smith et al. 1983, p. 655). However, they did not find any evidence for this relationship. Pearce and Gregersen (1991) made a similar argument linking interdependence to helpful behaviours. Citing work design theory (Hackman and Oldham 1976), they hypothesized that as interdependence increased so would helpful behaviours between those coworkers. They found support for their hypothesis, but only through the mediation of felt responsibility (see Section 3.3.1). Reciprocal interdependence correlated with felt responsibility ($r = .34$), and felt responsibility correlated with extra-role behaviour ($r = .23$).

Anderson and Williams (1996), in disagreement with Pearce and Gregersen (1991), proposed that while symmetric dependence may increase felt responsibility, it would also affect helping behaviour directly. They argued that an increase in interdependence would also increase the chance that the helper would realize that their coworker needs help, and then offer it spontaneously. This hypothesis was not supported. Instead, they found that task interdependence was indirectly related to helping behaviour through its large correlation to help seeking behaviour ($r = .39$). The finding suggests that being in frequent task-related contact with someone who can help will increase the chance that person will be *asked* for help, but will not affect that person's helping behaviour if not asked. Similarly, Settoon and Mossholder (2002) hypothesized that an increase in initiated task interdependence (Kiggundu 1981, 1983) would increase the chance a helper would recognize that their help was needed, and thus increase helping behaviours. Their hypothesis was not supported either; initiated task interdependence did not relate at all to helping behaviour.

de Jong et al. (2007) were the first to propose that asymmetric dependence would affect helping behaviour between team members. First, they found that if members of a dyad (A and B) were both highly dependent on each other, A's perceived receipt of help from B was highest. When members were both least dependent (still symmetrically interdependent, but with a low amount of dependence), A's perceived recept of help from B was lower, but still relatively high. This indicated a positive relationship between level of symmetric dependence and perceived helping behaviour. In a way this parallels the findings of the literature dealing with fit (see Section 3.2.2), but instead of a positive relationship between interdependence and performance there was a positive relationship between interdependence and helping behaviour.

The results for the asymmetric situations are more complicated. de Jong et al. (2007) found that when B depended on A, but A did not depend on B, A perceived low help from B. The authors hypothesized that when B did not depend on A, but A depended on B, A would perceive low help from B. In terms of power, when B was in power there would be a low amount of help, perhaps because B would take advantage and not help A (there would be no reason to). The authors did not find support for this hypothesis. Instead, the amount of help was the same in the absence of power and when B was in power. They explained the negative finding in three ways: one, perhaps the less powerful of the dyad cognitively justified the lack of help from the person in power, and simply didn't report it; two, the organization studied had large rewards based on group performance and the more powerful of the dyad took that into consideration and helped their coworker; and three, dyad members who had experienced lack of help from their more powerful coworker had left those relationships and formed other, more cooperative working relationships over time. The theoretical reasoning behind these hypotheses and findings are discussed in Section 3.3.7 on power below.

The survey findings on the effects of task interdependence are mixed. Some studies found no direct correlation between interdependence and helping behaviour, others found a strong positive correlation but only through mediating variables, and one study found evidence for a direct positive correlation.

Experimental studies

The studies investigating "fit" between interdependence and reward interdependence (Section 3.2.2) were concerned with its effect on performance. Wageman and Baker (1997) found that the same pattern of results could be found when the dependent variable was helping behaviour. Providing the reward interdependence was appropriate (individual rewards matched with low interdependence, and group rewards matched with high interdependence), as task interdependence increased so did the amount of helpful behaviours between team members. The authors then proved that it was the level of task interdependence that drove the helping behaviour, not the reward interdependence (Wageman and Baker 1997, p. 152). Allen et al. (2003) extended the Wageman and Baker (1997) method, and found that as task interdependence increases, so too do helping behaviour, consistent with previous findings. But they also found that helping behaviour was highest when high task interdependence was coupled with low reward interdependence, which is inconsistent with Wageman and Baker's findings. The experimental procedures used by Wageman and Baker (1997) and Allen et al. (2003) are discussed in detail in Section 5.1.1.

OCB scholars have long argued that helping behaviours should positively affect group performance (Organ 1988), but empirical studies have found that in some situations OCBs seem to reduce group-level performance (Podsakoff and Mackenzie 1994, p. 359). Podsakoff et al. (2000) proposed that the disparate findings could be a result of task interdependence; groups with low interdependence do not need to help each other. Indeed, helping could distract employees from their own work and cost more than they benefit (Bergeron 2007; Wong and Campion 1991, p. 834-835). Bachrach et al. (2006b) investigated this issue and found that in high interdependence conditions, an increase in helping behaviour correlated with an increase in performance. They hypothesized that in a low interdependence condition, increasing helping behaviour would correlate to a decrease in performance, but the evidence did not support this. The negative result could be attributed to their experimental method (see Section 5.1). Although not the focus of their study, they also found that as interdependence increases, so did helping behaviour, which confirms the previous experimental findings. The authors noted, however, "the condition effect is not too surprising because the task structure in the high task interdependence condition afforded group members more opportunity to help than in the low task interdependence condition" (Bachrach et al. 2006b, p. 1401).

This was an astute observation and an often overlooked factor in the relationship between interdependence and helpful behaviours (see Section 4.1).

In summary, experimental studies have found a consistent and strong connection between task interdependence and helping behaviour. As their interdependence increases, so too does helpful behaviour between team members.

3.2.4 Summary of the effect of interdependence

Scholars in the field of job design have tried to understand how characteristics of the job affect the worker's behaviour, perception, and motivation. Empirical evidence has been mixed, with some evidence that task interdependence enriches jobs by increasing motivation, felt responsibility, and satisfaction. Others have not found evidence for this correlation. Other scholars have eschewed the job design paradigm and focused on the antecedents and consequences of organizational citizenship behaviours. Some of those have specifically looked at interdependence and its effect on helping behaviour between team members. Those using field survey methods have had trouble finding a direct link between interdependence and helping behaviours, but have found evidence that points to its effect through the mediating variables of felt responsibility and help seeking. Those using experimental methods have found a consistent and strong relationship between task interdependence and both group performance and helping behaviour. Provided there is the appropriate reward interdependence, researchers have found that when interdependence increases, so too does performance, and so too does helping behaviour between team members.

3.3 Explaining the effect of interdependence on helpful behaviour

Of those studies investigating the effect of interdependence on helpful behaviour, some survey studies and all experimental studies have found the following relationship: as interdependence increases, helpful behaviours increase. With two exceptions (Bowler and Brass 2006; de Jong et al. 2007), these findings refer to situations in which the interdependence is symmetric (see Section 3.1.5 for the distinction between level and mutuality of interdependence). In the studies discussed in Section 3.2, the term "low interdependence" referred situations in cell (B) and "high interdependence" to situations in cell(D) in Table 3.2.

The empirical literature indicates that as level of dependence increases, so does the helping behaviour—at least in symmetric relationships. But why is this so? What would account for

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of	Low	(A) ?	(B) low helping beh.
Dependence	High	(C) ?	(D) high helping beh.

Table 3.2: The effects of interdependence on helping behaviours, according to literature

an increase in helping behaviour solely because the level of dependence increases? This section will attempt to answer that question. At least eight different explanations have been used to account for the pattern.

3.3.1 Felt responsibility

The job design literature has had relatively little to say about how interdependencies affect the outcomes that interest job design scholars (Kiggundu 1981, p. 499). Job design models have typically been interested in how core job dimensions (skill variety, task identity, task significance, individual autonomy, task feedback) influenced a worker's psychological states (the meaningfulness of their work, their felt responsibility for work outcomes, their knowledge of the actual results of work activities) and how these psychological states influence the worker's personal and work outcomes (internal motivation, work performance, work satisfaction, absenteeism and turnover) (Hackman and Oldham 1976, p. 256). The job design literature has been criticized because it does not "adequately take into account the fact that jobs exist as a network of interconnected positions" (Kiggundu 1983, p. 167), and until recently the situation had not improved (Morgeson and Humphrey 2006). And although Morgeson and Humphrey found no correlation between their interdependence measures and their work outcomes, further work in relational job design has argued that a strong link is indeed present.

Relational job design is a model which helps explain how jobs can be "structured to cultivate prosocial motivation: to increase employees' desires to protect and promote the well-being of beneficiaries" (Grant and Parker 2009, p. 328). Beneficiaries are those that receive the output of an employee's work. For example, the person that a fireman rescues, the shopper that a cashier checks-out, or the students who use a classroom that a janitor cleaned the night before. Grant unpacks and extends the concept of task-significance (Hackman and Oldham 1976) and argues that those jobs that impact their beneficiaries and provide contact with those beneficiaries will increase an employee's motivation to make a prosocical difference. Those jobs that lack contact with their beneficiaries prevent employees from gaining a deep understanding of how their work actions affect their beneficiaries.

Grant (2007) argues that there are two necessary components for motivation towards making a prosocial difference: perception of an impact, and affective commitment to beneficiaries. First, employees that perceive an impact on beneficiaries recognize that their behaviour leads to outcomes. The behaviour-outcome contingency is essential to motivating behaviour (Vroom 1964). But, according to expectancy theory, the outcome needs to have a positive valence. Second, then, the employee needs to value the outcome. Valuing the prosocial difference in a beneficiary's life is increased for two reasons. One, Grant (2007) cites benevolence, which is "the value of protecting and improving the welfare of other people with whom one is in regular contact" (p. 403). Two, individuals spend more effort to benefit those who are emotionally connected and important to them. Individuals see their beneficiaries as having similar identities because of this connection, and acting to help these beneficiaries is consistent with core personal values (Grant 2007, p. 404). Therefore, affective commitment to beneficiaries increases the outcome valence of the expectancy equation, and perceiving that their behaviour impacts their beneficiaries increases the behaviour-outcome component of the expectancy equation.

Although Grant (2007) is concerned with explaining why employees might help external beneficiaries of their work (and how to increase that motivation), the motivation to make a prosocial difference could also help explain some coworker-to-coworker helping behaviour. As level of dependence increases, perception of impact may also increase. According to Grant (2007) then, as level of dependence increases, so too might the motivation to make a prosocial difference. The explanation would be that the employee would perceive that they make more of an impact on their dependent (beneficiary) and would be motivated to help more. Crucially, this explanation rests on the assumption that an individual needs to like their coworker in order to be motivated to help. The individual would need to translate an affective concern for their coworker into a positive valence towards the outcome of "helping my coworker," in the same way that an individual is said to do for an outside beneficiary (Grant 2007, p. 404). That is, the individual emotionally connects with the coworker, the coworker is important to them, which leads to viewing the coworker as having a similar identity, and in order to remain consistent with the their core values the individual is motivated to do something prosocial for the coworker.

The motivation to make a prosocial difference is similar to one of the early attempts made to explain helpful behaviour between coworkers. Hackman and Oldham (1976) originally suggested that autonomy (freedom, independence, and discretion in one's work process and schedule) would lead to a feeling of felt responsibility for one's work (p. 258). As discussed in Section 3.1.2, Kiggundu (1981) built on their work and used findings from field studies of task groups in laboratory settings (Thomas 1957) and field settings (Horsfall and Arensberg 1966) to argue that workers who facilitated the work of others would experience a sense of

responsibility for their dependent's work. This felt responsibility could arise because the individual realizes that their dependent's ability to complete their task depends on the speed and quality of the individual's output. Further, the dependent's ability to receive performance-based rewards depends, in part, on the individual's timely and correct output. Supporting the felt responsibility perspective, Turner and Lawrence (1965) found a significant positive correlation (.53) between required interaction and the employee's sense of responsibility (Kiggundu 1981, p. 503).

Numerous studies have used Kiggundu's felt responsibility to argue that interdependence will lead to helpful behaviours. Pearce and Gregersen (1991) argued and demonstrated that felt responsibility will motivate helpful behaviours even in the absence of any reciprocation on the part of the dependent (see Section 3.3.5) (p. 839); Wong and Campion (1991) argued that as task interdependence increases so will the intrinsic motivational value of the job, in part because the worker will have an increased felt responsibility to work cooperatively with their coworkers who depend on them (p. 826-827); Anderson and Williams (1996) argued that the increased opportunity for interaction afforded by higher interdependence would lead to a higher felt need for helping (p. 285); Settoon and Mossholder (2002) hypothesized that an increase in initiated task interdependence would increase the chance a helper would recognize that their help was needed, activating a social norm of responsibility (Berkowitz 1972), and thus increase helping behaviours in order to reduce chances for social censure (Burke et al. 1976) (p. 259) ; Bachrach et al. (2006b) also used Kiggundu's felt responsibility argument and essentially confirmed the Pearce and Gregersen (1991) findings using an experimental study; and de Jong et al. (2007) cited felt responsibility as the reason to assume that increasing symmetric interdependence would increase helping behaviour (p. 1627). In short, most studies arguing for a link between interdependence and helping behaviour do so using felt responsibility.

3.3.2 Kahn's role theory as the basis for felt responsibility

Felt responsibility, and the related motivation to make a prosocial difference, are theories of motivation. Many of the papers cite Kiggundu (1981, 1983) as their foundation, but Kiggundu himself cited Kahn et al. (1964) as the motivational basis: "Kahn et al. (1964) argue that interdependence creates some pressure that arouses in the focal person a psychological force of some magnitude and direction" (p. 504).

The original theory linking role expectations to an individual's behaviour (whether performance in general or helping behaviours towards the role sender) is rooted in a power relationship. The motivational basis that Kiggundu refers to above is part of the basic questions, "How do role pressures from others create psychological forces on the person? How

do these forces combine with other forces to determine the person's behavior?" (Kahn et al. 1964, p. 186). These questions are part of the more general, "How do people influence each other's behavior? What are the bases or preconditions for influence? Under what conditions will the influence yield a result desired by the influencer?" (p. 186).

Kahn et al. (1964) start with the question of how expectations lead to psychological forces acting on the person. But then they shift the terminology to one of influence. "Role pressures are conceived as specific attempts to influence the behavior of a person in a given position. Under most circumstances they generate a set of psychological forces on the person, only some of which are in the direction intended by the influencer" (p. 187). Influence is seen to be primarily the result of power. "Role pressures are exerted through social influence processes and techniques which are based primarily in the formal role relations between the sender and the focal person... power is highly concentrated in the hands of his direct superiors. Legitimate power, reward power, and coercive power are almost exclusively theirs" (p. 205). In short, expectations result in psychological forces due to power. "If every effective role sending involves some power implication, that is, some consequences of compliance of noncompliance, what are the bases of that power? What influence techniques are available and under what conditions are they used" (p. 195)? And, "every attempt at influence implies consequences for compliance of noncompliance. In organizations these commonly take the form of sanctions... The availability and visibility of such sanctions are important, whether or not they are used or even threatened" (p. 16).

If Kiggundu (1981, 1983) used Kahn et al. (1964) as the theoretical justification that felt responsibility would lead to psychological forces towards helping, there must be a power component in the theory of felt responsibility. But such a component cannot be found in the original formulation (Kiggundu 1981) or in any of its adopters. If felt responsibility does create some force towards action on the part of the person who initiates the interdependence, it must do so using some other mechanism. The only mechanism so far identified is expectancy theory, as explained by Grant (2007): motivation towards helping behaviour requires a realization that their helping behaviour leads to positive outcomes for their dependent coworker, and that "helping my coworker" has a positive valence (see Section 3.3.1).

3.3.3 Perspective taking, empathy, altruism

The three closely related concepts of perspective taking, empathy, and altruism attempt to explain why an individual would help their dependent. They are overlapping concepts, and they all may share some part of the underlying mechanism creating the forces produced by felt responsibility. As such, and considering the vast literature behind each of the concepts, I will

not attempt to delineate exactly where each begins and the other ends. Instead I will review how management scholars have used the concepts as explanations for helping behaviour.

Perspective taking is the act of adopting another person's viewpoint. It is argued that perspective taking should increase empathy towards that person and their situation, and then increase altruism (Batson et al. 1997). Studies have supported this argument. For example, asking employees to take the perspective of their external supplier correlated with an increase in helping behaviours towards those suppliers (Parker and Axtell 2001). It would not be hard to imagine how perspective taking could also increase the empathetic concern towards a coworker, prompting an increase in altruistic motivation and a corresponding increase in helping behaviour.

Empathy, or empathetic concern, is "an emotional experience of compassion and feeling for another in need and is directly associated with empathetic responding outcomes, like ICB [interpersonal citizenship behaviours, i.e., helping behaviour]" (Settoon and Mossholder 2002, p. 258). Eisenberg and Miller (1987) review the social psychology literature on empathy and found that there is typically a correlation between .10 and .31 between empathic concern and prosocial behaviours (p. 113). Investigating if this general finding held true for situations at work as well, McNeely and Meglino (1994) found a .18 correlation between empathy and interpersonal prosocial behaviours. Settoon and Mossholder (2002) had hypothesized that initiated task interdependence would directly correlate with helping behaviour (citing felt responsibility) but failed to find a significant correlation. But they did find a significant correlation from perspective taking to emphatic concern ($r = .41$) and from emphatic concern to task-focused interpersonal citizenship behaviour ($r = .31$).

Altruism commonly refers to behaviour motivated to increase another person's welfare, which is often (but not always) self-sacrificing in the absence of obvious, external rewards (Batson 1998, p. 282). There is a great deal of social psychological research on altruism and the situational factors which influence altruistic behaviours (see Batson 1998, for a review). Organizational scholars often cite Krebs (1970) when arguing that task interdependence increases contact between coworkers which increases the chances of altruistic behaviours (e.g., Bachrach et al. 2006a, p. 194; Bachrach et al. 2006b, p. 1397; de Jong et al. 2007, p. 1627). Although no current management theories incorporate altruism as the single explanation for helping behaviours between coworkers, it is usually implied or referenced when it is hypothesized that as interdependence increases so does helping behaviour.

Ultimately though empathy and altruism are labels for behaviour that appears to be altruistic or empathic. Labeling a behaviour as altruistic doesn't explain it, and appealing to altruism as the mechanism for helping behaviour verges towards tautology. Explanations involving empathy and perspective typically end in a similar manner. Why did that employee

help (act altruistic, display empathy to) their coworker? Because they were helpful (altruistic, empathic). Why *didn't* they help (act altruistic, display empathy to) their coworker? Because they *were not* helpful (not altruistic, not empathic). A more satisfactory explanatory mechanism is needed.

3.3.4 Help seeking and norms

Although coworkers can help each other spontaneously, perhaps by recognizing that help is needed and then offering it, past research has indicated that most help is given only after it has been asked for. In a survey of 53 managers in a variety of work environments, Burke et al. (1976) found that 92% of help was given after the helpee had requested it (p. 373). In a replication, Kaplan and Cowen (1981) found that over 75% of the time help was given in response to a direct request for help (p. 635). Perhaps then a direct answer to the question of why would an individual help their dependent coworker would be, "because they asked for help." But this shifts our focus onto the request for help. The question then becomes, how does the dependent's request for help create a force towards helping behaviour in the individual being asked? Flynn and Lake (2008) argue that the request for help creates a situation in which refusal to help is a behaviour to avoid. In essence, Flynn and Lake argue that instead of a force *towards* helping behaviour, as is proposed by the previous sections, a request for help creates a force *away* from refusing to help.

Flynn and Lake (2008) are concerned with individuals who actively ask for help, their perceptions of the chance that the responder will help, and whether or not the responder gives help. In the Flynn and Lake (2008) experimental situations, the help seekers are strangers to those who are asked. Although that is a different situation than one in which a dependent coworker asks for help, the results may be enlightening. The author varies the directness (whether the help was asked for explicitly, or implied; or whether the help was asked for verbally, or through a hand-out sheet of paper), the experimental situations (hypothetical situations vs. face to face situations), and the extent of help requested (short vs. long surveys). One purpose is to show that when a help seeker takes the perspective of a help-giver, they estimate more help will be offered. Crucial for our current topic, Flynn and Lake argue that help seekers underestimate the amount of help they will receive, and this is because the help seeker underestimates the negative effects of a help-giver refusing to give help. Help seekers do not understand that "denying a request for help can be awkward and embarrassing because it violates a social norm to assist those in need" (p. 141).

Flynn and Lake (2008) proposed that the force towards helping is a force away from refusing to help. Refusing to help would "be violating an implicit norm of benevolence (Brown

and Levinson 1987; Goffman 1971; Gouldner 1960)" (Flynn and Lake 2008, p. 128). Further, "In many cases, people are motivated to comply with a request for help in order to avoid the feelings of embarrassment that might be induced by noncompliance" (p. 129). And although they didn't investigate help seeking behaviour, Settoon and Mossholder (2002) argued that interdependence would increase the chance a helper would recognize that their help was needed, activating a social norm of responsibility (Berkowitz 1972), and thus increase helping behaviours in order to reduce chances for social censure (Burke et al. 1976; Settoon and Mossholder 2002, p.259). Thus, helping behaviour is seen as the result of a motivation away from embarrassment which could arise from violating an implicit norm of benevolence, responsibility, or reciprocity.

This is an intriguing solution to the problem, and it could even be applied to the previous sections. I contend that labeling behaviour altruism does not enhance our understanding of why people are motivated to behave that way (e.g., they act altruistically because they are altruistic). But perhaps the behaviour can be better explained as an attempt to avoid being seen as non-altruistic, in situations that expect altruistic behaviour. The theory then becomes more persuasive as we move from a dispositional explanation (a person acts altruistically because they are high in altruism) to a situational explanation (a person acts altruistically because they were placed in a situation that expected them to act in an altruistic way). A move from dispositional to situational explanations coincides with recent calls for a renewed situational psychology, begun by Kurt Lewin (e.g., 1939; 1964) but often given little attention by social psychologists (Reis 2008) (see Section 3.3.6) .

3.3.5 Social exchange theory

Bowler and Brass (2006) note that organizational citizenship behaviours are performed for the organization as a whole, whereas interpersonal citizenship behaviours (ICB, or OCBI) are performed for another person. OCB research has usually focused on job satisfaction and other attitudinal variables that reflect an employer-employee interest, such as the organization-to-employee, employee-to-organization, supervisor-to-subordinate, or subordinate-to-supervisor relationship (Cropanzano and Mitchell 2005, p. 878). For example, Shore et al. (2006) investigate how perceived organizational support (POS) affects an employee's level of OCB, their overall performance, absence, and tardiness. As a result, "most OCB researchers have largely failed to address the possible exchange between employees... Research has largely ignored the individual relationships between employees" (Bowler and Brass 2006, p. 71).

It is this interpersonal interaction that we are concerned about when we ask the question, why and under what conditions would an individual help out their dependent? Social exchange theory addresses these questions directly by proposing that long-term interpersonal

relationships both explain and predict the helping behaviour between coworkers.

Social exchange theory is not a theory, but a framework or set of concepts and principles to apply to problems of interpersonal interaction (Emerson 1976, p. 336). As such, social exchange is broad ranging, overlapping with and sometimes encompassing other explanations for interpersonal behaviour, such as Interdependence Theory (Section 3.3.6) and the perspective taken by Behavioural Economics (Section 3.3.8). Each has it's own unique explanation for our behaviour of interest, but social exchange theory appears to be the most inclusive.

Emerson (1976) described social exchange as "the economic analysis of noneconomic social situations" (p. 336). Social exchange theory is an attempt to apply the concepts of "reward, reinforcement, cost, value, utility, resource, comparison level, transaction, profit, outcome, etc" to interpersonal interactions (p. 347). An interaction is an exchange of resources, with costs and benefits to each party, resulting in mutual rewards. Rewards can vary from monetary to the slightest signs of social acceptance, such as "eye contact with a smile, which evokes valued approval" (p. 336). In general, social exchange theory is proposed to be "a unitary framework for much of organizational behaviour" (Cropanzano and Mitchell 2005, p. 875).

Flynn (2005) discusses three types of social exchange: direct negotiated exchange, direct reciprocal exchange, and generalized exchange. Direct negotiated exchanges are openly negotiated with terms discussed and agreed to ahead of the exchange, and typically occur between individuals unsure of their relationship ("I'll cover your shift but only if you cover mine next week"). Direct negotiated exchanges are also referred to as "economic exchanges" (Shore et al. 2006, p. 839). In contrast, direct reciprocal exchanges are between individuals in a stronger relationship. It is taboo to explicitly discuss terms; the exchange is implied and expected sometime in the future ("Don't worry about it, I'll cover your shift"). Reciprocal exchanges depend on trust (Blau 1964), and involve "obligations, trust, interpersonal attachment, or commitment to specific exchange partners" (Emerson 1981, p. 35). Finally, generalized exchanges occur between networks of people, sometimes but not necessarily belonging to the same organization. Person A helps out B, B helps out C, and sometime in the future C helps out A. Peer reviews for journals, external examiners for PhD defences, and other professional activities among professors are examples of generalized exchange.

In symmetric situations, the literature has used social exchange theory in a round-about way to argue for a positive correlation between interdependence and helping behaviour. Settoon and Mossholder (2002) used social exchange theory (without directly naming it) to argue a direct link between interdependence and helping behaviour: "When interdependence among coworkers is higher, expectations of exchange and reciprocity should be intensified"

(p. 259). In fact, the first paper on organizational citizenship behaviours implicitly used social exchange theory to argue that increasing interdependence would increase helping behaviours. Smith et al. (1983) argued that interdependence would foster a collective sense of social responsibility (Krebs 1970), and would tend to promote "higher levels of group cohesion than other task environments" (p. 655). They hypothesized that symmetric dependence would influence OCBs through the mediating mechanism of group cohesion and job satisfaction (p. 656). A more general proposition, which was not directly tested, is that symmetry allows for the leader-member and member-member exchange of prosocial behaviour (p. 655). An act of prosocial (helpful) behaviour then becomes subject to norms of reciprocity (Gouldner 1960), and equity (Adams 1965), in that an individual may choose to do acts of OCB in order to repay a previous kindness. Similarly, Anderson and Williams (1996) used leader-member exchange to argue that helpful behaviours from a leader will be reciprocated by helpful behaviours back to the supervisor from the employee (p. 283-284).

In asymmetric situations, the effect of social exchange is less clear. In general, social exchange theory posits that when an individual decides whether or not to help a coworker, the decision involves evaluating the extent that the coworker is known to, friends with, or has helped the individual in the past (reciprocity). The theory would expect that a coworker who is very well known, a close friend, and has helped the individual in the past will receive more help than one who is not known and has not helped in the past. Bowler and Brass (2006) used social exchange theory to argue that if an individual (Person A) is in an asymmetric relationship with a dependent other (Person B), that is, A does not likewise depend on B, we should expect that A will not feel that force towards helping behaviour. There are two reasons given for this lack of helping behaviour. One, citing impression management literature, they argued that B (the dependent) would use helping behaviours as a form of ingratiation to A, with the hopes of impressing them. "It is also unlikely, however, that the dependent individual will receive ICB [helping behaviours] from the person who is the target of his or her ICB because that person *has no need* to impress the dependent other" (Bowler and Brass 2006, p. 72) (emphasis mine). Two, citing relational influence and power literature, they argue that the power imbalance between A and B (B is dependent on A, therefore A has the power) will affect the force that A feels towards helping behaviour. Specifically:

> Because social exchange relationships are based on equivalence between exchange partners, an exchange relationship between the two employees of unequal influence is not likely. The higher influence actor clearly *has little to gain* from providing services to the low-influence individual (Bowler and Brass 2006, p. 73) [emphasis mine].

Social exchange theory explains helping behaviour given to a dependent in terms of what

the help giver needs, or what the help giver has to gain from giving help. If giving help has no future value, or is not in repayment for a prior exchange, there would be no rational reason the individual to give help. "This model assumes that people are motivated by self-interest when they interact with others" (Tyler and Smith 1998, p. 612). It is, "the economic analysis of noneconomic social situations" (Emerson 1976, p. 336). However, as there is no official theory of social exchange theory, we cannot be sure if the hypotheses derived from it by Bowler and Brass (2006) would be accepted by all social exchange theorists. Instead, a more specific and formalized approach, which many consider to be one of the foundations of social exchange, is interdependence theory.

3.3.6 Interdependence theory

Describing the problems of the social psychology field, Reis (2008) states:

> On one hand, we trumpet the power of situations and contexts (a concept that few outsiders would deny, at least in abstract terms). Indeed, our research has provided impressive, even incontrovertible, evidence to support this assertion. On the other hand, in the more than half-century since Gordon Allport, Solomon Asch, Kurt Lewin, and others first defined the social in social psychology in terms of situations, the field has yet to develop a clear, consensual definition or taxonomy of what situations are, how they might be systematically compared, and which ones are most influential in what ways (p. 312).

In broad terms, interdependence theory (Thibaut and Kelley 1965; Kelley and Thibaut 1978; Kelley et al. 2003) is an attempt to create an objective description of the situation and derive its affect on an individual's behaviour. Situations are viewed as social affordances, as opportunities for individuals to express motives, goals, values, and preferences. "A friend in need is an occasion to assist, exploit, or ignore; a job that needs to be done is a chance to divide labor, delegate, or do it oneself; and a romantic partner who prefers to vacation somewhere different from one's personal preference is an opportunity to be generous or pig-headed" (Reis 2008, p. 316).

In specific terms, interdependence theory describes a situation in terms of an outcome matrix which describes the payoffs associated with each available choice. Using interdependence theory, one derives an individual's most probable action based on those payoffs. Interdependence theory, similar to social exchange theory, explains an individual's behaviour in terms of what they receive from that behaviour. Underlying both theories is an assumption that an individual prefers more payoff to less payoff, an assumption that the behavioural

economists have dubbed "The Selfishness Axiom" (see Section 3.3.8). Although, it must be noted that Kelley (1979) disagree with this interpretation. They explicitly stated that "the potentialities of outcome matrices have been underestimated and widely misunderstood," (p. 15) in reference to social psychologists who assumed that outcome matrices implied that there was no room for prosocial motives "such as altruism, cooperation, and the desire for justice" (p. 15). This issue will be taken up below in the discussion of given vs. effective outcome matrices.

The term interdependence is used because usually the outcome of person A will depend on the choice that B makes, and the outcome of B will depend on the choice that A makes. The matrix may also describe a situation in which A makes a choice and their outcome is the same regardless of B's choice, and similarly B makes a choice and their outcome is the same regardless of A's choice; A and B are independent. On the other hand, if A's outcome cannot be affected by B's choice, but B's outcome is affected by A's choice, it is said that A is independent of B, and B is dependent on A; asymmetric dependence.

The outcome of A and B is represented by a number, which is a conceptual abstraction representing gain, loss, happiness, sadness, money, information, or anything of value or of interest to the person. Much like the numbers used in preference functions in economics models, there is the assumption that the person will prefer a 5 over a 4, is ambivalent between a 5 and a 5, and is ambivalent about a 0. And much like economic preference functions, the exact numbers do not matter, only that higher outcomes are always preferred over lower outcomes.

		Bob	
		run	*bike*
Alice	*run*	$5, 4$	$3, 5$
	bike	$2, 2$	$3, 6$

(a)

		Bob	
		run	*bike*
Alice	*run*	$5, \ \ 4$	$3, -3$
	bike	$2, -4$	$3, \ \ 6$

(b)

Figure 3.1: Alice and Bob's interdependent situations

For example, Figure 3.1(a) shows an independent situation between Alice and Bob. The left number in each of the cells is Alice's outcome, the right number is Bob's outcome. If Alice chooses to run and Bob chooses to run, Alice will receive a 5 as her outcome, Bob will receive a 4 as his outcome. If Alice chooses to run and Bob chooses to bike, Alice receives an outcome of 3, and Bob an outcome of 5, and so on. The situation is considered interdependent because given a choice by Alice to run, Bob can determine whether Alice receives an outcome of 5 or an outcome of 3. Similarly, if Bob chooses to bike, Alice can determine whether Bob receives an outcome of 5 or 6.

The effects of interdependence can become very powerful, as can be seen when some outcomes are negative. Consider Figure 3.1(b). Suppose Bob would rather bike than run, but would dislike spending time away from Alice. If Bob decided to go for a bike Alice would have a great amount of power over Bob's outcome: if she chooses to bike, Bob's outcome will be 6; if she chooses to run, Bob's outcome is -3.

The preceding example raises an important question: who chooses first? Can the other change their mind? Can the participants negotiate and decide on a choice together? Does interdependence theory prescribe how two interdependent people arrive at their decision?

For game theoretic situations in behavioural economics, players choose independently and simultaneously (see Section 3.3.8). Interdependence theory does not have this condition or restriction. The matrix represents the outcomes after choices have been made, but it makes no assumptions or prescriptions about how decision comes about. The participants may be involved in a behavioural economic-type game with simultaneous decisions, or they may be in a long standing relationship and are discussing which option they should both take. Kelley (1979) give an example situation drawn from Tolstoy's short novel "Family Happiness": "Suppose the two plans had been discussed. Sergey's announcement that he liked plan X would have brought Marya to instant accord. She would even have been happy to agree on plan Y and so would Sergey, but neither would have espoused either plan if the other had espoused a different plan" (p 11). Tolstoy's situation is similar to the one represented in Figure 3.1(b).

Kelley et al. (2003) use this game theoretic framework to derive 21 situations. Each situation represents a different way in which two people can be interdependent. For example, Chicken describes a situation where two people (usually males) drive their cars towards one another at high speed (Kelley et al. 2003, p. 203). The one who veers first is the coward (the "chicken"), the one who doesn't has more courage. If both veer it is embarrassing, but neither can accuse the other of being more cowardly. If neither veers, they collide, and both "win." The situation is represented in Figure 3.2. The Kelley et al. (2003) situations frequently use the same names that game theorists use. For example, battle of the sexes (p. 219), and the prisoner's dilemma (p. 177).

		Bob	
		veer	*stay*
Adam	*veer*	$-3, -3$	$-9, \quad 3$
	stay	$3, -9$	$-15, -15$

Figure 3.2: Representation of classic game of "Chicken"

Where do the numbers in the outcome matrix come from? In most cases the numbers are illustrative and meaningful only in a relative way. Adam is assumed to prefer 3 over -9,

but it is not implied that Adam will receive $3 for winning the chicken game, or lose $15 for crashing his car. The outcome matrices are used to illustrate and analyze a situation and the forces acting on each participant, not represent a realistic outcome. However, real numbers have been used. For example, 100 heterosexual pairs of UCLA undergraduates who had been living with a partner for 3 or more months were asked to rate on a scale of -10 to 10 four possible events: both clean the apartment, I clean the other doesn't, the other cleans and I don't, and we both don't clean. The results are presented in Figure 3.3. According to the data, it would appear that males do not mind if their female partner cleans (as long as someone cleans). Females on the other hand dislike it if only the male cleans, almost as much as they dislike when neither cleans. But both would prefer to clean with their partner.

		Males	
		clean	*not*
Females	*clean*	$+9, +7$	$0, +1$
	not	$-3, -1$	$-4, -3$

Figure 3.3: Survey data for "Cleaning the apartment"

Asymmetric dependence

Asymmetric dependence refers to a situation where an individual has an individual (a partner, a coworker, a friend, etc.) who depends on them, but they do not share that dependence. I noted before that this situation has been left relatively unexamined by management literature (see Table 3.2). The situation is better understood in the context of interpersonal relationships (Kelley et al. 2003, p. 249-267). In terms of interdependence theory, asymmetric dependence can be represented as Figure 3.4. Bob depends on Alice, but Alice does not depend on Bob. Alice can make choice a1 or a2 and receive the same outcome regardless of Bob's actions. In other words, Alice is independent of Bob. Bob's outcome, on the other hand, is completely controlled by Alice's choice. It doesn't matter whether Bob chooses b1 or b2, if Alice choose a1 Bob will receive 5, if Alice chooses a2 Bob will receive 0. This situation describes a completely asymmetric relationship where Bob has absolutely no control over his outcome, Alice has complete control.

		Bob	
		$b1$	$b2$
Alice	$a1$	$4, 5$	$4, 5$
	$a2$	$7, 0$	$7, 0$

Figure 3.4: "Asymmetric dependence:" Bob is dependent on Alice, Alice is not dependent on Bob

In the interpersonal relationships literature, asymmetric dependence is tied directly to

power. "In situations involving asymmetric dependence, one person can influence the well-being of a second person, whereas the second person can exert little or no influence over the well-being of the first. One person holds relatively greater power; the other is relatively more dependent" (Kelley et al. 2003, p. 249). As such, the ways in which asymmetric dependence explains helping behaviour will be discussed in Section 3.3.7.

Given vs. effective matrices

There is a distinction made between the *given* matrix and what is referred to as the *effective* matrix (Kelley 1979, p. 181). The given matrix is the external, objective set of payoffs. However, many individuals do not act according to their given matrix; they chose outcomes that do not maximize their payoff, i.e., they act irrationally. Kelley (1979) note that "there is much research evidence for its [the given matrix's] invalidity... Raw matrix values are simply not satisfactory predictors of behavior" (p. 15). This indicates that the matrix which is operating at the time of choice is not the given matrix, but the *effective* matrix. The effective matrix represents the outcomes that the individual perceives and acts upon at that moment.

The original Thibaut and Kelley (1965) formulation of outcome matrices were criticized for implicitly assuming that interpersonal behaviour was ultimately driven by "narrowly hedonistic assumptions," (Kelley 1979, p. 15) or what the behavioural economists would refer to as The Selfishness Axiom. By introducing transformations, Kelley (1979) found a way to take properties of the player (e.g., personal prosocial preferences for equality, cooperation, or altruism), and properties of the situation (e.g., how much more or less their outcome will be compared to their partner's, that is, their relative outcome) and adjust the given matrix in light of these individual differences. The adjustment is the transformation process which results in the effective matrix.

Summary

Interdependence theory offers an elegant and powerful framework to describe almost every type of interpersonal situation (Kelley et al. 2003). Each interpersonal situation can be described objectively (with the given outcome matrix) and is transformed on an individual basis according to that person's values, dispositions, attitudes, needs, or beliefs about the future, into a subjective situation (the effective matrix) (Kelley 1979, p. 16). The individual then behaves rationally according to their effective matrix, and picks the action that will yield the highest outcome. They would be expected to make a choice resulting in a 5, over a choice resulting in a 4. In other words, interdependence theory explains behaviour using the same mechanism as social exchange and economic game theory.

Given a situation where an individual is faced with helping a dependent, according to interdependence theory why and under what conditions would they offer that help? The individual would help their dependent because that action had the highest benefit. Helping their dependent was a rational, benefit-maximizing choice at the time. Their cost benefit equation takes into account their personal preferences for acting prosocially, being altruistic, being a team player, and so forth, all of which combine to create the individual's effective matrix, or simply their subjective cost and benefits. Thus, the conditions under which the individual will help is answered by the individual's effective matrix. However, in order to develop a hypotheses about a particular situation, one would need to know the individual's preferences and all other personal factors that would alter the given matrix. Unfortunately then, an observer would know an individual's *true* effective matrix only after the choice had been made. If the choice to help was made, then helping must have had more subjective benefit than cost. If the choice to not help was made, then not helping must have had more subjective benefit than cost.

3.3.7 Power and influence

The possible explanations for an individual's choice to help their dependent has been divided into multiple perspectives above. It should be clear by now that this division is somewhat arbitrary. Many of the previous approaches have had an underlying reference to power and influence. And although referencing a similar set of literature, the different perspectives arrive at two contradictory explanations and hypotheses. Those that have appealed to a norm explanation have argued that those in power will help their dependent. Those that have appealed to the social exchange and power and influence literature have argued that those in power will not help their dependent.

Role theory (Kahn et al. 1964) explained that the force that a sender's expectations exert on a focal person is a result of the sender's ability to *influence* the focal person. Influence is tied to power, which in organizations is exerted through rewards and sanctions resulting from the focal person's compliance or noncompliance. Role theory was used explicitly by Kiggundu (1981, 1983), and implicitly by subsequent researchers (e.g., Pearce and Gregersen 1991), as the mechanism behind the force that Felt Responsibility exerted on an individual's behaviour toward their dependent. Although role theory was used as an explanation for the force towards helping behaviour, the felt responsibility researchers were either not aware of the power and influence basis of Kahn et al. (1964), or they chose not to use power and influence as a component of their argument. In fact, the hypotheses derived from felt responsibility are in conflict with those derived from power and influence (see also Section 3.4).

Researchers in the help seeking literature have argued that seeking help is inextricably

linked with power. To seek help is to acknowledge one's dependence on another person, and coupled with the admission of relative ignorance or incompetence, places the help seeker in a less powerful position (Lee 1997, p. 339). Individuals are motivated to "maintain positive public impressions and selfimages, and this usually entails being competent and independent, in short, being powerful. Both of these motivations are threatened when one seeks help from another." (Lee 1997, p. 340). Lee (1997) found that when individuals were of unequal status, less help was sought. The help giver's motivations and the help given were not investigated.

Social exchange theory is implicitly concerned with power, in that it describes a person's actions with respect to the costs and benefits they get out of an interaction. Those costs and benefits are related to the power imbalance in the relationship; an individual in power can gain less benefit from a dependent. It was hypothesized that because there are minimal benefits to gain, a powerful individual is not motivated to help a less powerful dependent (Bowler and Brass 2006, p. 73).

Finally, in interdependence theory, asymmetric dependence is treated as a pure problem of power and influence (Kelley et al. 2003, p. 249). Indeed, "the concepts of dependence and power are inextricably related, in that to the extent that one person (A) is relatively more dependent, the other (B) is relatively more powerful" (Rusbult and Van Lange 2003, p. 355). The formalization of power as a function of dependence dates back to the 60's when Emerson (1962) recognized that "to say that 'X has power' is vacant, unless we specify 'over whom.' In making these necessary qualifications we force ourselves to face up to the obvious: power is a property of the social relation; it is not an attribute of the actor" (p. 32). Formally, "$Pab = Dba$; the power of A over B is equal to, and based upon, the dependence of B upon A." Dab is A's dependence on B, which is "(1) directly proportional to A's *motivational investment* in goals mediated by B, and (2) inversely proportional to the *availability* of those goals to A outside of the A–B relation" (p. 32–33). A can reduce their dependence on B by reducing their desire for that which B has control over, or by finding another source for achieving their goal.

The dynamics of power are well studied in interpersonal relationships. For example, a beautiful women may have more alternatives than her less attractive partner, giving the woman power in the relationship; children learn that they lose power by depending on a friend too much, and gain power when they take an "I don't care what you do" attitude; and a similar dynamic occurs in adult relationships where the partner who is relatively less involved in the relationship "calls the shots," as often does the partner who controls or brings home more of the economic resources (Kelley et al. 2003, p. 253, 262). The pattern repeats itself in employee-employer relationships as well, and has been termed "rational selective exploitation." Employees with attractive alternatives and mobility are more valuable and command higher salaries compared to those who are tied down to a particular company or

area because of job-specific training, investments, or family commitments (Kelley et al. 2003, p. 264).

The giving of help is complicated in interpersonal relationships. In some cases helping behaviour from an individual in power may have unintended consequences. It is argued that because of the prevalence of norms of reciprocity, help receivers are often placed in difficult situations where they know that they will be unable to repay favours. Help receivers feel resentful and hostile towards those offering help, welfare recipients experience a humiliating loss of freedom and privacy, and siblings often feel embarrassed or resentful about seeking help from one another (Kelley et al. 2003, p. 259). Depression-era behaviour and government policies attempted to reduce these consequences; hobos attempted to retain some pride by offering to do chores for food, and the government instituted make-work programs (Kelley et al. 2003, p. 260).

According to the interpersonal power and influence approach used in interdependence theory, what would influence a power holder to help their dependent? There are two competing forces identified. One, the power holder may be influenced by social norms to help their dependent: such as norms of fairness, norms of *noblesse oblige*, contributions-based norms (resources should be allocated based on a concept of "deservingness"), or needs-based norms (resources should be allocated based on each person's needs, regardless of what they have contributed in the past or what they may contribute in the future). It is apparent that these norms are formulated more for interpersonal relationships (such as parent-child asymmetry, or rich-poor asymmetry) than working relationships. Perhaps the norms identified in Section 3.3.3 would be more appropriate. Regardless, this approach indicates that the power holder would be influenced by norms of benevolence (among others) to help their dependent.

Two, the power holder may be influenced by their own rational goal directed behaviour. "It is easy to imagine that power holders typically will pursue their personal interests and ignore others' interests" (Kelley et al. 2003, p. 254). In experiments simulating the interactions between a company with power (A) and a company without power (B), Tjosvold (1981) found that when in a competitive situation (A and B's goals were in conflict; if B reached their goals it prevented A from reaching theirs) participants from A perceived that they had little choice but to pursue self interest. While in a cooperative situation (A and B's goals were aligned such that if A reached their goals, B would as well, and vise versa) A felt that helping B was worth the cost. The experiment was related back to following or violating norms: "In the absence of powerful social norms or higher order goals favoring benevolence, it is not surprising that power holders frequently behave in a self-oriented manner" (Kelley et al. 2003, p. 255).

de Jong et al. (2007) take the second approach and contend that the interpersonal power and influence literature supports the conclusion reached by the social exchange theorists—that the power holder would gain little by helping their dependent, and therefore would not help. There are two explanations for this behaviour. First, asymmetry in power creates a situation where the more powerful partner has more options and alternatives available to them (as part of the definition of dependence, Dab, above), and can withhold support and exit the situation at a lower cost than their partner (Cook and Emerson 1978; Cook et al. 1983). Asymmetry in relationships tend to generate negative effects, such as less voluntary help, an agitated and negative emotional experience, increased use of threats and coercion, and instability and incompatibility (Rusbult and Van Lange 2003). "In such a situation, the more powerful team member may feel little need to invest in the relationship, which makes it less likely that he or she will voluntarily help the less powerful person" (de Jong et al. 2007, p. 1627).

Second, an experimental study found that the dependent in a relationship (B) was found to "think hard" about the power holder's (A's) behaviour, in an effort to predict and control that behaviour, while A had been found to spend less time and cognitive effort towards observing and interpreting B's behaviour (Depret and Fiske 1999, p. 465–466). This data has been used to argue that power holders would have less need and less incentive to pay attention to the actions and behaviours of their dependent (Fiske 1993, p. 621). Therefore, even if B helps A, or B tries to signal their trustworthiness or their intent to help, A will simply not perceive B's helpful behaviour (de Jong et al. 2007, p. 1627).

Both explanations were used to argue that as the asymmetry worsens (A's relative power increases), A would perceive less helpful behaviour from B, and as symmetry returns (A's relative power decreases), A would perceive more helpful behaviour (de Jong et al. 2007, p. 1627). However the authors did not find support for this hypothesis; individuals with more power perceived about the same extent of help from their partner as those with less power.

3.3.8 The behavioural economic perspective

One of the main goals of the behavioural economics research program is to understand and explain how individuals make decisions. It is particularly relevant to this dissertation because it provides the most scientifically rigourous analysis of the assumptions and explanations that underly social exchange theory and interdependence theory.

It has been noted above that the social exchange theory and interdependence theory explain human behaviour as a choice between alternatives. This choice occurs after available

(subjective, perceived, etc.) costs and benefits have been weighed. The choice is the logical, rational one that maximizes the individual's net benefit. This is the same model of choice described by psychological decision theory, based on the rational actor model, which is considered to be "one of the great scientific achievements of all time" (Gintis 2009, p. 245). The rational actor model assumes that individuals seek to maximize their utility, where utility is defined in terms of individual benefit (e.g., money). This is known by some as the *self-interest assumption* (Camerer 2003a, p. 48) or the *selfishness axiom* (Henrich et al. 2005, p. 797). The selfishness axiom is the bedrock of microeconomics and Agency Theory (Bottom et al. 2006). However, it has been long known that "this model of decision making was motivated as much by its analytic tractability and intuitive appeal as it was by empirical facts" (Hagen and Hammerstein 2006, p. 340).

The rational actor model has been subject to a long and sustained critique (e.g., most notably by the Tversky and Kahneman (1974) program of research). Loss aversion, base rate fallacy, framing effects, conjunction fallacy, among many other fallacies and biases have demonstrated that humans systematically diverge from the predictions made by the simple rational actor model (Gintis 2009, pp. 21–29, 246). Henrich et al. (2005) state that the selfishness axiom has been thoroughly challenged by empirical evidence:

> Hundreds of experiments in dozens of countries, using a variety of game structures and experimental protocols, have suggested that in addition to their own material payoffs, students care about fairness and reciprocity and will sacrifice their own gains to change the distribution of material outcomes among others, sometimes rewarding those who act prosocially and punishing those who do not. Initial scepticism about such experimental evidence has waned as subsequent studies involving high stakes and ample opportunity for learning have repeatedly failed to modify these fundamental conclusions (p. 797)

Indeed, psychologists have stated that "game theoretic rationality in the service of personal profit maximization is not an adequate model of human decision-making in social bargaining situations. . . The idea that this simple game theoretical account is descriptive rather than normative is surely dead in experimental economics and psychology" (Barclay and Daly 2003, p. 154). But, rather than disproving it, Gintis (2003, 2009) argues that the critiques have been incorporated into the rational actor model, which is all the stronger for it:

> There is no alternative to the traditional decision-theoretic model on the horizon, and there is not likely to be one, for one simple reason: the theory is mostly correct, and where it fails, the principles accounting for failure are complementary to, rather destructive of, the standard theory (Gintis 2009, p. 246).

There is currently a great deal of debate over which form the revised standard theory will take (see for e.g., Colman 2003; Henrich et al. 2005). It would take a great deal of space and lead too far off track to review every alternative and their pros and cons, so the focus will remain on trying to answer the question guiding this dissertation: why and under what conditions would an individual help their dependent? Behavioural economics is concerned with the exact same question when it asks, why and under what conditions would an individual behave prosocially towards another? The experiments which are most useful to answering these questions are the dictator game and the ultimatum game, both of which will be described below. I will then discuss the leading behavioural economic explanation for prosocial behaviour: other-regarding preferences.

The ultimatum game

There are two players in the ultimatum game, a proposer and a responder. The experiment is typically "one-shot" and anonymous, meaning that the participants (usually college students) know that there is another person playing (not a computer) and that they will not find out who that person is, nor will they exchange roles or play that same person again. The proposer is given a fixed amount of money from the experimenter and told to divide it for themselves (p) and for the responder (r). The responder is given a take-it-or-leave-it option to accept the proposal, in which case they receive r and the proposer receives p, or reject the proposal, in which case they both get nothing. After the responder makes their choice they receive their proportion (if any) and the experiment ends. Typically the game is played with $10.

According to the rational actor model the responder should accept any positive r, because they are a rational profit-maximizing actor and something is better than nothing (Hagen and Hammerstein 2006, p. 340). The proposer, knowing this, will offer the smallest positive r and keep the largest possible p.

When actually played, "the self-regarding outcome is almost never attained or even approximated" (Gintis 2009, p. 57), which is "the kind of empirical finding that surprises only economists" (Camerer 2003a, p. 43). In dozens of replications of this experiment, using a range of fixed amounts of money, but typically with western college students, proposers offer an average of 40% (many offer half) and responders reject small offers of around 20% around half the time (Camerer 2003a, pp. 43, 50–55).

Many economists argue that the participants in dictator games would behave more like rational agents (that is, according to the selfishness axiom) if the stakes were raised. Typically these experiments use $10 as the pie to divide. As the stakes rise, studies have found no statistical difference in rejection rates, and in one study with $400 stakes, rejection rates were only slightly lower than typical (Camerer 2003a, p. 60).

> The frequency of rejections of large dollar amounts is striking…In List and Cherry (2000) a quarter of the subjects who were offered $100 out of $400 rejected it. It is tempting to conclude that these subjects were "confused," but this explanation is acceptable only if confusion is measured independently of whether a subject's behaviour deviated from somebody's pet theory (Camerer 2003a, p. 61).

This behaviour clearly violates the selfishness axiom. If players are not behaving according to their self-regarding preferences, what is happening?

Behavioural economists argue that the ultimatum game is a precise way to measure "social preferences" such as trust and fairness. These concepts, usually amorphous and difficult to quantify, can be precisely valued: a responder that rejects $2 out of a pie of $10 places a $2 value on how much they dislike being treated unfairly (Camerer 2003a, p. 44). This is called "negative reciprocity," and it is assumed that a responder rejects a positive offer when they feel that the division is unfair. Rejection, then, is a way for the responder to punish the proposer. Further, behavioural economists have found that social preferences are, in part, cultural. It has been shown in an elaborate study involving 15 small-scale societies around the world, that there is significant cross cultural variability in what is considered fair (Henrich et al. 2004, p. 19).

Considering that a proposer is giving money to a responder at a cost to themselves, giving generous amounts to the responder is labeled altruism (West et al. 2007). However, given that the responder can reject an offer as a way of punishing an unfair division, if a proposer offers a generous r, are they doing so because they care about the welfare of the responder at the expense of their own benefit, or are they trying to avoid a rejection? That is, to what extent does the ultimatum game really indicate that the proposer is acting altruistically? The dictator game was designed to answer this question.

The dictator game

The dictator game is the same as the ultimatum game, except that the responder cannot reject the offer. By removing the option to reject, experimenters are able to remove fear of rejection as an explanation for giving generously to the receiver. "If Proposers offer positive amounts in a dictator game, they are not payoff maximizing, which suggests some of the generosity in ultimatum games is altruistic rather than strategic" (Camerer 2003a, p. 56). Extensive experimentation has found that the mean offer in dictator games is about 20%, compared to the about 40% offered in ultimatum games. This indicates that there was some strategic playing (avoiding rejection) in the ultimatum game, and some "pure altruism."

But does offering about 20% actually indicate altruism? Or could it be that the proposer knows they are being watched, recorded, and perhaps judged by the experimenter? Understanding the long history of experimenter effects in social psychology research, Hoffman et al. (1994) implemented an ingenious method of double-blind experimentation. The proposers were given an envelope with 10 dollar bills and 10 blank slips (the same size as dollar bills) and directed to a booth. The proposer was instructed to take any 10 bills or slips out of the envelope, leaving 10 bills or slips inside. For example, if the proposer took 9 bills and 1 slip out, they were allocating $9 to themselves and leaving $1 for the receiver. This way the experimenter could not tell how much money the proposer took from the envelope when they carried it out of the booth and deposited it into a box. After all proposers had finished, the experimenter opened the envelops and recorded the frequency of the allocations. The receiver participants then drew random envelopes to receive their allocation.

More than half the proposers left nothing and the mean allocation was only 10%, which was significantly less than the control conditions without double-blindness. Following this line of research, other studies have attempted to increase "social distance" through other mechanisms, but none had succeed in reducing the mean allocation over the standard dictator condition (Camerer 2003a, p. 62). In summary, Camerer (2003a) argues that anonymity does not reduce all allocations in dictator games to levels predicted by the selfishness axiom, and believes that these double-blind findings indicate that there is some component of altruism at work.

The double-blind experiments controlled for experimenter effects, but did they control for the effects of other participants? Perhaps social forces are created by the other participants. The proposer knows that another human will receive their allocation, that this human is a fellow student, and possibly even in the same class. Most importantly, the receiver will know what the fixed amount was and that the proposer divided it up in such a manner. Understanding that there is a self-similar receiver and that they will know their choice, the proposer may feel social forces towards being generous. Certainly such a situation and motivation is not unrealistic at all, but, crucially, this motivation is different than altruism. As H.L. Menken said, "Conscience is the inner voice that warns us somebody may be looking."

Dana et al. (2006) tested the effect of visibility by setting up a traditional $10 dictator game. But, after the proposer had decided on the allocation, they were told that the receiver at that point had no knowledge of the game being played. If they wanted, the proposer could take $9 and walk away (an "exit option"), and the receiver would never be told what had happened. Otherwise the experiment would continue as normal, the receiver would be given their allocation and told the rules of the game and the original fixed amount. According to rational agent theory no player should chose the ($9, $0) exit option, as it is "dominated" by the ($10, $0) and ($9, $1) options. The findings showed that about one third of the

participants chose to exit the game, taking $9 and giving the receiver nothing. A second study tested to see if it was the receiver's perceptions about the proposer that prompted the proposer's exit. A "private dictator game" was created, where the proposer was told that the receiver will receive their allocation as part of the payment for an unrelated task. The receiver would be ignorant of the proposer's choice and the dictator situation. In the private dictator game only one participant (out of 24) chose the exit option ($9, $0), indicating that it was the receiver's perception of the proposer that influenced the exit behaviour in the first study. The authors concluded that:

> In this way, invisibility affords more freedom to be unjust than does total power and anonymity. The dictator game affords the dictator power and anonymity, but not invisibility, since the receiver still knows that someone has money to divide. Just knowing that one is the anonymous dictator that the receiver will think badly of can be sufficient to compel giving (p. 201).

Dana et al. (2006) argue that generous gifts in the dictator game are due to the desire not to violate the expectations of the receiver, rather than a pure altruistic concern for their welfare (p. 193).

Explaining behaviour in economic games

How do economists explain the behaviour of participants in the ultimatum and dictator games, and can this be used to understand helping behaviour in work situations? Game theorists predict participant's behaviour in games using Rational Choice Theory (RCT), which has two components: 1) a preference function which has variables accounting for an individual's desires (goals, or utilities), which are unique to each individual and act to motivate the individual's behaviour; 2) rational calculation and evaluation of outcomes of possible behaviours, which lead to an individual choosing the behaviour that results in the maximum utility given their preference function (Heintz 2005, p. 825). Although in early formulations the rational calculation and evaluation component assumed complete information and a high level of reasoning, current formulations do not. Participants make decisions subject to information and material constraints. Even the selfishness axiom, the assumption that individuals seek to maximize only their own material gains and assume that other individuals do the same, is no longer a core assumption of RCT (Henrich et al. 2005, p. 812).

The decades of behavioural economics work, of ultimatum, dictator, and other games, have all demonstrated that individuals take the interest of others into account when they make their proposals and allocations. But instead of disproving the RCT framework, these

findings have prompted an adjustment in the preference function equation. It is the selfishness axiom which is at fault (Camerer 2003b, p. 157). Instead of including only the individual's utilities, the functions now include *other-regarding preferences*. Other-regarding preferences take many forms, such as inequality aversion (Camerer 2003a, p. 102), fairness (Camerer 2003a, pp. 105, 107), and many other competing approaches (see Colman (2003), Henrich et al. (2005) and their commentators for a wide range of alternatives).

Other-regarding preferences are now considered to be the best approach to dealing with evidence that indicates that individuals do not obey the selfishness axiom. Other-regarding preferences match how we see normal humans behave in real life; it is argued that because of cultural norms (of reciprocity, altruism, benevolence, and so forth), only sociopaths would consider complete selfishness at all times to be in their best interest (Gintis 2009, p. 52). The evidence from economic games are used to argue that other-regarding preferences are *the* explanation for why individuals do not behave according to the selfishness axiom, and that because game theory has incorporated other-regarding preferences into the preference equations it is now the strongest theory of human behaviour (Gintis 2009, p. 246). Indeed, some argue that it is now only an empirical matter to determine the correct form for those other-regarding preferences (Camerer 2003b, p. 157).

But these arguments largely sidestep the findings from Hoffman et al. (1994) and Dana et al. (2006), which show that anonymity reduces an individual's other-regardingness to almost nothing. To reconcile, Dana et al. (2006) proposed that an individual's utility function should include: $-\alpha|\mu - m|$, where the parameter α is the proposer's sensitivity to the receiver's expectations, and $|\mu - m|$ is the absolute difference between the receiver's expectations (μ) and the amount the dictator gives (m). The model says that if the proposer is sensitive enough, they will conform to the receiver's expectations (Dana et al. 2006, p. 200). However, rather than incorporate social expectations into game theory, an admission that would profoundly disturb game theory's commitment to *methodological individualism* (Colman 2003, p. 150), Gintis (2009) argues that participants must have incorporated norms into their preference functions: "The most plausible interpretation of these results is that many subjects felt obliged to behave according to certain norms when playing the Dictator Game, or violated these norms in an uncomfortable way, and were willing to pay simply not to be in a situation subject to these norms" (p. 76).

Perhaps Colman (2003) sums up the behavioural economic explanatory approach best:

> We are so much attached to the notion of rationality that we are always ready to repair it, but not to abandon it. The theory of rationality is, in fact, a formalization of a naive theory of human thinking. This naive theory makes it possible to predict human behavior in most everyday situations in the same way

> as naive physics makes it possible to predict natural phenomena in everyday life. However, no one takes naive physics so seriously as to claim that it provides "the explanation" of the world. Moreover, even refined and formalized versions of this naive theory, like Newtonian mechanics, are shown not to be valid; and more complicated and counterintuitive theories at the microlevel, like quantum mechanics, have been invented. On the contrary, rationality theory is taken seriously, especially in economics, as an explanation of human behavior (p. 167).

However, one should be careful not to place too much explanatory validity on other-regarding preference functions. It is often forgotten that "the important uses of game theory are prescriptive (e.g., giving people good advice) and descriptive (predicting what is likely to happen), because good advice (and good design of institutions) requires a good model of how people are likely to play" (Camerer 2003b, p. 157). Although it is implied by some (notably Gintis (2003, 2009)), game theory is not designed to *the* realistic model and explanation of what actually happens inside an individual's head. Individuals do not calculate and evaluate preference functions to maximize their utility, even if that utility includes other-regarding preferences. What is needed is a more phenomenologically valid approach that can explain why an individual would help a dependent when they don't have to (see Section 4.2 for one possible approach).

Relating the dictator and ultimatum game to helping behaviour

It has been argued that helping behaviour between coworkers is often personally costly to the help giver, at the time that the help is given, because it prevents them from completing their own work (Bergeron 2007). If time and effort is considered a limited resource, it would not be too great a stretch to see how helping a coworker could be considered costly to the giver, but provide an immediate benefit to the receiver. Help-giving could be considered similar to giving money to the receiver. In this case dollars represent time and effort which is a scarce resource and valuable to both workers. This analogy between help-giving and money exchange simplifies many complexities relating to perceptions of help versus perceptions of money, motivations related to work compared to money, and so forth. But it is essentially the perspective underlying social exchange theory, interdependence theory, and resource dependence theories (Staudenmayer 1997). For now these simplifying assumptions can help more than they hurt, much like anechoic chambers help speaker engineers, and frictionless inclines helped cannoneers (Lewin and Gold 1999, pp. 37–66) and (Aronson et al. 1990, p. 76).

The dictator game is useful to approximate a situation where an individual (A) has a dependent (B). In power terms (Section 3.3.7), A has relatively more power than B, because

A determines B's allocation of money. In interdependence theory terms (Section 3.3.6), B is asymmetrically dependent on A for their rewards. The traditional dictator game can be used to evaluate the extent to which A "helps" B, and does so with exceptional clarity and precision (helping is quantified in exact dollar amounts), but only if we make a number of assumptions about their situation. The assumptions include (but may not be limited to): A does not know B; A will not interact with B again; and A will not reverse roles some time in the future. These assumptions are clearly unrealistic for most situations, especially work situations where A and B are coworkers, know each other, may have relationships with one another both in and outside of work, expect to work with each other again in the future, have superordinate goals, have organizational cultural norms, and have various task-related constraints either restraining them from, or encouraging them towards helping behaviour. In other words, the dictator game ignores all social and technical factors of a work relationship. Given these obvious deficiencies, what could the dictator game possibly teach us about helping behaviour between coworkers?

The dictator game is useful precisely *because* it strips away all social factors. The behavioural economics research program was partly designed to systematically isolate social factors, removing every plausible alternative explanation for prosocial behaviour. The description above reviews only a small number of the hundreds of studies that have manipulated all possible social and experiment variables that could account for helping behaviour. This methodical scientific approach has isolated participants to an extent never before realized, all in order to determine the baseline, the very foundation-level of helping behaviour. I believe we have almost reached that bedrock in the Dana et al. (2006) study. The Hoffman et al. (1994) study demonstrated that the social forces created by the experimenter could account for some of the generous giving, but not all of it. It was concluded that the remaining giving must be altruistic. But then the Dana et al. (2006) study isolated proposers from their receivers, demonstrating that almost all the remaining generous giving was in response to the social expectation exerted by the receiver. If the double-blind (Hoffman et al. 1994) and isolated receiver studies (Dana et al. 2006) were combined, we should expect that there would be zero generous giving by the proposer. What is left, in the dictator game, are two individuals who have no reason to help one another. The strength of the behavioural economics approach is that researchers can start with this bedrock level of social isolation, add social forces piece by piece, and measure their effects in dollar values.

The previous sections have reviewed organizational studies that have tried to discover the reasons for helping behaviour through surveys and experiments. Often researchers sift through dozens of personal, task-related, and behavioural variables and try to find correlations to valued work outcomes (Section 3.2.1), performance (Section 3.2.2), and helping (Section 3.2.3). The experimental studies by their nature provide stronger links between in-

terdependence and helping behaviour, but there are relatively few to learn from and their methods and findings are often muddled and inconclusive (Sections 3.2.3 and 5.1.2). Organizational scholars can learn much from behavioural economics experiments, which are systematic, clear, and methodologically sharp (see Gintis (2009, pp. 49–52) and Camerer (2003a, pp. 34–42) for thorough explanations and arguments for experimental rigour).

The most important finding for explaining helping behaviour in work situations is the effect of social expectations. Removing social expectations removed almost all generous giving (Dana et al. 2006). This indicates that behaviour which had previously been labeled (for lack of a better explanation) altruistic, may have been the result of social expectations.

The extent that this finding is generalizable to other situations or other experiments is not known. Also not understood well by behavioural economists is how "social expectation" should be represented and analyzed. Expectation is a social psychological construct, and as can be seen in the last section, the economist's solution is to turn it into a variable in an individual's preference function, or call it a norm. I contend that the correct way to deal with the force created by a social expectation is through social psychological theory (see Section 4.2) which is decidedly *not* a methodological individualistic explanation. In fact, I would argue that behavioural economists have been treating a lot of social behaviour as the result of an individual's choice over a preference function. That is, they have assigned a cognitive explanation for something that is social—the interaction between two individuals.

3.4 Predictions based on previous theories

This section will collect and summarize the empirical, theoretical, and logical arguments reviewed in Section 3.3. Recall that we are interested in answering the following question: why and under what conditions will an individual help their dependent? In Section 3.1.5 I distinguished between level and mutuality of dependence, each of which I argued will independently affect the amount of helping behaviour. This means that the following set of questions need to be answered.

3.4.1 What are the effects of interdependence on helping behaviours?

As the level of dependence increases from low to high, what is the effect on helping behaviour? In an asymmetric situation this would mean, holding all else equal, if the extent to which B depends on A increases, would A change their helping behaviour towards B? This can be illustrated as a transition from cell (A) to cell (C) in Table 3.3. In a symmetric situation this would mean, holding all else equal, if the extent to which B depends on A and A depends

on B increases, would A and B change their helping behaviour towards each other? This is illustrated as a transition between cell (B) and cell (D). What predictions would previous theories make for these changes in level of dependence?[4]

As the dependence changes from asymmetric to symmetric, what is the effect on helping behaviour? In both the low and high levels of dependence this would mean, holding all else equal, if at first A does not depend on B, would A change their level of helping behaviour if the situation changed so that A likewise depended on B? This is illustrated as a transition from cell (A) to (B), and from cell (C) to (D).

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of	Low	(A)	(B)
Dependence	High	(C)	(D)

Table 3.3: The possible effects of level and mutuality of dependence on helping behaviours

3.4.2 General empirical findings

With two exceptions, those empirical studies dealing with helping behaviour have investigated symmetrically dependent situations. While some have reported nonsignificant findings, all significant findings have indicated that as level of dependence increases from low to high, that is, as we move from cell (B) to (D), helpful behaviour increases. These generally accepted findings are illustrated in Table 3.4. The transitions between cells (A) and (C) are less well understood; the predictions based on theory are conflicting, and empirical findings have been nonsignificant (Bowler and Brass 2006; de Jong et al. 2007). The empirical effects of a change in mutuality of dependence is currently unknown (Table 3.5).

		Mutuality of dependence	
		Asymmetric	Symmetric
Level	Low	(A) ?	(B) lower helping beh.
of		↕	↓
Dependence	High	(C) ?	(D) higher helping beh.

Table 3.4: The effects of a change in level of dependence: findings from past empirical research

[4]It will be assumed throughout the following discussion that predicting a change in one direction implies that moving in the other direction would bring about the opposite change. For example, if a theory predicts an increase in helpful behaviours when moving from cells (B) to (D), that theory would predict a reduction in helpful behaviours when moving from cells (D) to (B).

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of	Low	(A) ? $\longrightarrow$	(B) ?
Dependence	High	(C) ? $\longrightarrow$	(D) ?

Table 3.5: The effects of a change in mutuality of dependence: findings from past empirical research

3.4.3 Felt responsibility

Felt responsibility argues that as level of dependence increases, contact and understanding between coworkers would increase, allowing A to realize the impact they have on B, and vise versa (see Section 3.3.1 for details). This perceived impact increases their motivation to help. But, crucially, the argument rests on A *liking* B, because the outcome valence of "helping my coworker" needs to be positive for motivation to increase. Other researchers add to the argument, stating that the motivation is also created by a felt need to adhere to a social norm of responsibility. Felt responsibility supports the following hypothesis: when moving from cell (B) to (D), helping behaviour will increase due to an increase in felt responsibility. Felt responsibility also supports: moving from cell (A) to (C), helping behaviour will increase due to an increase in Person A's felt responsibility. No empirical study has tested this second hypothesis. Moving from cell (A) to (B) or (C) to (D) would presumably increase the amount of contact between A and B, and would probably increase A's perception of the impact they have on B. The following hypothesis would then be reasonable: moving from (A) to (B) and from (C) to (D) would increase helping behaviour due to an increase in A's felt responsibility. No empirical study has tested this third hypothesis. See Tables 3.6 and 3.7 for an illustration of the hypotheses derived from the felt responsibility arguments.

3.4.4 Norms

Often researchers who primarily use other explanations (such as perspective taking, felt responsibility, help seeking, social exchange theory, interdependence theory, or power and influence) appeal to empathy, or various norms of altruism, reciprocity, equity, or benevolence to support their argument (see Sections 3.3.3 and 3.3.4). As dependence increases, A realizes that B depends on them in order to complete their task, and feels a force to obey social norms and help B. In general, if level of dependence increases, or if mutuality changes from asymmetric to symmetric, it could be argued that A will somehow feel a greater need to obey social norms and help an ever more dependent B.

The following hypotheses would be expected to hold: moving from cells (A) to (B), and (C) to (D) (see Table 3.6), or from (A) to (C), and (B) to (D) (see Table 3.7) would lead

to a relative increase in helping behaviour, due to an increased pressure to conform to social norms, or to avoid the appearance of violating social norms. Since the norm explanation is implicit or explicit in so many studies of helping behaviour it is unclear how much support each norm has and for which cell transitions. It would be safe to say that since most empirical evidence supports an increase in helping behaviour when moving from cell (B) to (D), this would suggest that norms may have had a place to play in those results.

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of	Low	(A) lower helping beh.$\longrightarrow$	(B) higher helping beh.
Dependence	High	(C) lower helping beh.$\longrightarrow$	(D) higher helping beh.

Table 3.6: Effect of a change in mutuality of dependence, according to theories of felt responsibility, social norms, social exchange, and behavioural economics

		Mutuality of dependence	
		Asymmetric	Symmetric
Level	Low	(A) lower helping beh.	(B) lower helping beh.
of		$\downarrow$	$\downarrow$
Dependence	High	(C) higher helping beh.	(D) higher helping beh.

Table 3.7: Effect of a change in level of dependence, according to theories of felt responsibility, social norms, and behavioural economics

3.4.5 Social exchange theory

Predictions based on social exchange theory are mixed (see Section 3.3.5). Classic studies on helping behaviour in organizations used social exchange theory to predict that as interdependence increased, so should helping behaviour. But their findings were inconclusive. Current studies maintain that in symmetric "equivalent" relationships, social exchange theory predicts an increase in helping behaviour due to the norms of reciprocity, responsibility, altruism, and even group cohesion. The following hypothesis would be expected to hold: moving from cells (A) to (B) and (C) to (D) would increase helping behaviour between A and B due to a strengthened social exchange relationship (see Table 3.6).

Current theorists have argued that social exchange relationships are based on equivalence between exchange partners. If B is dependent upon A, A would have little to gain from helping B. Ultimately, the decision to give help is made in terms of what the help giver needs, or what the help giver has to gain from giving help. Therefore, if giving help has no future value, or is not in repayment for a prior exchange, there would be no reason for the individual to

give help. The following hypotheses were therefore proposed (Bowler and Brass 2006, p. 72): as asymmetric dependence increases, moving from cell (A) to (C), helping behaviour from A will decrease due to a weakened social exchange relationship; as symmetric dependence increases, moving from cell (B) to (D), helping behaviour from A will increase. Or, following the nomenclature of the previous hypotheses and tables: moving from cell (C) to (A) would increase helping behaviour from A, and moving from cell (B) to (D) would increase helping behaviour from A and B, both due to a strengthened social exchange relationship (see Table 3.8).

		Mutuality of dependence	
		Asymmetric	Symmetric
Level	Low	(A) higher helping beh.	(B) lower helping beh.
of		↑	↓
Dependence	High	(C) lower helping beh.	(D) higher helping beh.

Table 3.8: Effect of change in level of dependence, according to theories of social exchange, power and influence, and interdependence theory

3.4.6 Interdependence theory, power and influence

For symmetric relationships, interdependence theory and theories of power and influence would hypothesize the same relationship as social exchange theory; social exchange theory is often used to explain symmetric relationships within these theoretical frameworks (see Sections 3.3.6 and 3.3.7). Thus, the predictions for movement from cell (A) to (B) and (C) to (D) would be illustrated by Table 3.6, and for the same reasons as social exchange theory.

With regard to asymmetric dependence (cells A and C), Interdependence Theory and theories of power and influence argue that power holders are influenced by two competing forces: social norms, and self-interest. As noted above, social norms would influence a power holder to help their dependent, or risk violating the norms. Self-interest, on the other hand, influences a power holder to pursue their own agenda, sometimes at the expense of their dependent. Using similar logic as the social exchange theorists, and using arguments from impression formation and social judgment literature, the power-dependence literature indicates that as a power holder increases their power, they do not need to pay attention to their dependent's behaviour, invest in their relationship with their dependent, require help from, or feel the need to spend effort giving help to their dependent. The following hypotheses would be proposed (de Jong et al. 2007, p. 1627): as asymmetric dependence increases, moving from cell (A) to (C), A will perform fewer helping behaviours; in symmetric relationships, as level of dependence increases, moving from cell (B) to (D), A and B will perform

more helping behaviours. The predictions of power and influence literature correspond to the predictions of the social exchange theory (see Table 3.8).

3.4.7 Behavioural economics

The axiom of selfishness would clearly produce the same hypotheses as social exchange theory, interdependence theory, and power and influence (Tables 3.6 and 3.8; see Section 3.3.8). However, behavioural economists have found that individuals do not behave according to the axiom of selfishness. In order to account for this, researchers have added *other-regarding preferences* into their decision-making model, rational choice theory. Other-regarding preferences are argued to be an economist's operationalization of social norms which have proven to be fit through through evolution (Gintis 2003). Other researchers have demonstrated that those social norms argued to be responsible for apparent other-regarding behaviour, such as altruism, are actually responses to social expectations. Removing the social expectations from the experimental situation has been shown to reduce helping behaviour to almost nothing.

The relative contribution of other-regarding preferences and/or forces felt from social expectations is still a matter to be decided through further study. What is clear, and widely agreed to, is that humans do not behave *purely* selfishly. As such, the empirical results from behavioural economics would *probably* support the following hypotheses: moving from cells (A) to (B), and (C) to (D), or from (A) to (C), and (B) to (D) would lead to a relative increase in helping behaviour (illustrated in Tables 3.6 and 3.7, respectively). Although past behavioural economic experiments indicate that this is the pattern organizational researchers should expect to find, these predictions have not yet been tested in economic experiments with task-related groups.

Chapter 4

Theory

Section 3.4 summarized how the literature has explained and predicted the effect of interdependence on helping behaviour. Previous work has not considered that level and mutuality of dependence are independent factors affecting helping behaviour. Or, having considered it, previous work has offered conflicting explanations and predictions for their effects. A new theory is needed to clarify the effect of level and mutuality of dependence on behaviour. The hypotheses will be tested in the experiment in Chapter 5.

Interdependence is hypothesized to affect helping behaviour in a two-step process. First, task-dependence affords the ability and opportunity for help. Second, situations of task-dependence create social expectations. Unmet social expectations create an unbalanced state filled with tension which gives rise to forces towards helping behaviour. As an analogy, higher levels and mutuality of dependence opens a door for helping behaviours, and the social expectations created by the situation motivates the helper to walk through.

4.1 Interdependent situations afford helping behaviours

The review in Section 3.4 and its tables raises two questions: why would an increase in the level of dependence, ceteris paribus, lead to an increase in helping behaviours? And: why would a change from asymmetric to symmetric, ceteris paribus, lead to an increase in helping behaviours?

It was noted in Section 3.1.1 that what we refer to as interdependence is a result of a division of labour which creates a task relationship. Person B is dependent upon A only to the extent that their ability to complete their task is affected by A's actions (or lack of

actions).[1] When minimally dependent on A, B is affected by a small set of A's actions.[2] The extent to which A can affect B's ability to complete their task is relatively limited. Even given A's most unhelpful behaviour, B will be able to compensate and complete their task. Likewise, when maximally dependent on A, B is affected by a large set of A's actions. A can affect B's ability to complete their task to a great extent. Given A's most unhelpful behaviours, B is unable to compensate in order to complete their task. But, given A's helpful behaviours, B is able to complete their task much quicker.

Interdependence is task-related, which is key to understanding how a situation constrains and allows helping behaviours. If B has a high level of dependence on A, A is able to perform task-related behaviours that help and do not help B. But if B has a low level of dependence on A, A will find it more difficult to to perform task-related helpful and unhelpful behaviours, simply because B is not as dependent upon A as before. In situations with low levels of dependence, the set of A's helpful and unhelpful task-related behaviours is smaller than it would be in situations with high levels of dependence. To be clear, in low dependence situations, A would still be able to go "above and beyond" their job description and help B, but doing so is *less* convenient, *less* appropriate, or *less* fitting. The same would hold true for unhelpful behaviours; in situations of low dependence, A would be able to go out of their way to be unhelpful to B, but doing so is *less* convenient. A low dependence situation constrains A's ability and opportunity to help and not help. Conversely, dependence affords A the ability and opportunity to help B, in the same way that objects afford some actions and not others (Gibson 1977; Norman 1988).

Gibson (1977) argues that an object in its environment exists independent of those perceiving it. Its form is reflected by light and perceived by a human or animal. Depending on the human's life space they will perceive the object as having particular subjective uses and properties. For example, a pen on a table affords a student the ability to write; if the student is having trouble opening their desk the pen now affords a levering or crowbar action; if the student is trying to open a stubborn backpack zipper the pen affords a prying action; or if the student is trying to make a mask out of paper the pen affords a poking action. Norman (1988) uses Gibson's theory of affordances to explain how people learn to cope with the tens of thousands of distinct objects in everyday life. We cope by intuitively understanding how things work, by observing their affordances, constraints and mappings (Norman 1988, p. 12).

Like objects which afford and disafford uses, high dependence situations afford A the

[1] As defined by Thompson (1967) and most others, interdependence involves work products, resources, information, or anything that the dependent would find useful to complete their task. I am using the term "actions" because, presumably, an individual would need to take an action (or not take an action) in order to send (or fail to send) whatever it is that the other is dependent upon.

[2] See also the discussion on the difference between level and mutuality of dependence in Section 3.1.5.

ability to help and not help B more than do situations of low dependence. Without the affordances that high dependence situations provide, high levels of helpful and and unhelpful behaviours are at best more difficult to perform, and at worst are simply not possible.

Viewing situations as providing affordances for behaviour is supported by previous organizational research. Interdependence theory views situations as "social affordances" that provide "opportunities for acting, interacting, and being acted upon" (Reis 2008, p. 316). High interdependence affords communication between team members (Gladstein 1984, p. 501). Situational affordances were implicitly used by OCB researchers to explain why OCBs do not positively affect group performance in all situations. They argued that OCBs improve performance only in interdependent situations, because only interdependent situations *need* helping behaviours (Podsakoff et al. 1997, p. 268) and (Organ 1988, p. 109). Further, when finding a strong correlation between high levels of symmetric dependence and helping behaviours, Bachrach et al. (2006b) noted: "the condition effect is not too surprising because the task structure in the high task interdependence condition afforded group members more opportunity to help than in the low task interdependence condition" (p. 1401).

In symmetric situations where A and B depend upon each other, and where there are high levels of dependence, there is more interdependence and more interaction (Brass and Burkhardt 1993, pp. 445–446) and (Settoon and Mossholder 2002, p. 258). More interaction leads to more chances to offer help (Anderson and Williams 1996; Podsakoff et al. 1997; Bachrach et al. 2006b; Organ 1988, p. 109). As Weick (1979) remarked, "When two people encounter one another, there is some possibility that each can benefit the other. For each, the contact with another person affords the possibility of increased need satisfaction and self-expression" (p. 90).

On the other hand, low levels and non-mutuality of dependence have been argued to constrain (or not require) interaction (Stewart and Barrick 2000, p. 137). In groups that lack interdependence (members are relatively independent), helping behaviour and coordination between teammates is simply not needed so it is not performed (Wageman and Baker 1997, p. 154), and when performed wastes time and effort (Liden et al. 1997, p. 176).

In summary, previous research has indicated that symmetric situations and a high levels of dependence require more interaction and afford the ability and opportunity for more helping behaviour. It is expected that moving from cell (A) to (B) will lead to a higher probability of helpful and unhelpful behaviours, as will a move from cell (C) to (D), from (A) to (C), and from (B) to (D) (see Table 4.1). Hypotheses derived from this argument are presented in combination with those derived from balance theory in Sections 4.2.4 and 4.2.3.

Symmetric and high dependence situations afford A the ability to help. However, opening the door and allowing helping behaviour is necessary but not sufficient to produce helping

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of Dependence	Low	(A)	(B)
	High	(C)	(D)

Table 4.1: The possible effects of level and mutuality of dependence on helping behaviours

behaviours. Even though the situation affords an increased probability of helpful and unhelpful behaviour, *why* would A help B? Why not more unhelpful behaviour? A must feel forces towards helping B. The forces are a result of the situation creating social expectations for helping behaviour.

4.2 Interdependent situations create social expectations and cognitive tension

Above and beyond the ability and opportunity to help given to A, highly dependent situations also result in B *needing* more actions from A (Podsakoff et al. 1997, p. 268) and (Organ 1988, p. 109). If in a situation of low dependence, A can act as they wish and B's ability to complete their task is only minimally affected. But as dependence increase, so too does B's need for A to act in a way that allows B to complete their task. The need from B is a social expectation on A to act in a way that allows B to complete their task, and an expectation to not act in a way that prevents B from completing their task. Social expectations create a force on A towards action by creating a situation of cognitive inconsistency—acting in an unhelpful way will disappoint B, violate B's expectations, and will create cognitive tension in A. Naturally, expectations only create forces towards action under some conditions. The conditions are understood by examining the cognitive unit triad that is formed by A, B, and B's expectations, the cognitive inconsistency created by the unit, and the manner in which that inconsistency is resolved. Heider's balance theory explains this process.

4.2.1 Balance theory

Theories of cognitive consistency are based on the Gestalt laws which describe how people prefer good perceptual forms and balanced states that minimize stress (Wertheimer 1938). Consistency theories are influential in social psychology, and include psychological balance (Abelson and Rosenberg 1958), system strain or symmetry theory (Newcomb 1953), cognitive dissonance theory (Festinger 1957), among others (Eagly and Chaiken 1998, pp. 282–284).

While not as influential as Festinger's version, Heider's balance theory (Heider 1946, 1958) was the first and simplest (Fillenbaum 1968, p. 177). Recent research has used balance theory to understand problems such as consumer psychology and marketing (Woodside and Chebat 2001) and the process of group problem solving (Adejumo et al. 2008). A more general concept of tension has been used to help explain altruistic behaviour: an individual experiences tension when they see somebody in need, and altruistic behaviour reduces that tension (Batson 1998, p. 287). Balance theory has not been used to explain helping behaviour in organizations.

Heider's theory involves structure and dynamics. Heider proposed that a person's attitudes towards people and things can be represented as a cognitive structure, viewed as a triad, composed of three *elements*, and *relations* between those elements (Heider 1946, 1958). A structure of elements and relations can be balanced or unbalanced. When balanced, the structure is stable. When unbalanced, the structure produces forces which encourage change towards a more balanced state.

First, the elements include the reference or focal person (p), the other person in the situation (o), and an impersonal entity (x) (Figure 4.1). The entity x could be an idea, an attitude, an event, a situation, a thing, etc. Relations include: sentiments, such as liking, valuing, esteeming (L), or their opposites ($\sim L$); and unit relationships, which means belonging to, possession, similarity, proximity, causality, or membership (U), or their opposites ($\sim U$). A structure is always considered with respect to the reference person, p. When p has an attitude towards o, or belongs in a unit with o, it can be represented as a positive relation (L or U) or a negative relation ($\sim L$ or $\sim U$). For example, p liking their friend o is represented as pLo; p disliking a rival is represented as $p{\sim}Lo$. Likewise, when p has an attitude towards the thing x, it can be represented with a positive L or negative $\sim L$ relation. Or, when p has a unit relationship with x (they own it, or they made it), it can be represented with a positive U or negative $\sim U$. For example, p likes the ice cream (x) is represented as pLx, or p made the ice cream is represented as pUx. Similarly, o also has a positive or negative relationship with x. The relation between o and x is perceived rather than actual, because the relation exists from p's point of view.

Second, Heider proposed that a dynamic structure exists between the p–o cognitive dyad and between the p–o–x cognitive triad. I will only discuss the triad condition here. The basic premise of Heider's theory is that cognitive structures tend towards balance. The person perceiving an unbalanced state will experience forces towards change. If change is not possible, the person will experience tension and stress (Heider 1958, p. 201). In the case of three elements, "a balanced state exists if all three relations are positive in all respects, or if two are negative and one positive" (Heider 1946, p. 110). Mathematically, balance exists if the product of the three relation signs are positive, and unbalanced if the product is negative

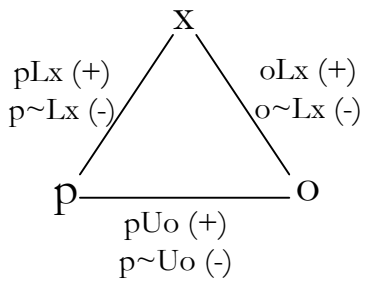


Figure 4.1: The basic cognitive unit-sentiment triad, p-o-x, with possible positive (+) and negative (-) relations

(Adejumo et al. 2008, p. 85). An unbalanced state can be made harmonious, "either by a change in the sentiment relations or in the unit relations" (Heider 1958, p. 207), which means a change in one of the relation signs so that the product is positive.

Consider a situation in which a person (p) believes that the current health care system (x) is morally unjust and should be changed, and p's good friend (o) believes the system works well. The situation, pLo, oLx, $p{\sim}Lx$, is in an unbalanced state (Figure 4.2a). Changing the sentiment relations would bring balance in the following ways. One, p can start to feel that perhaps the health care system isn't as broken as they thought: $p{\sim}Lx \rightarrow pLx$ (Figure 4.2b). Two, p can attempt to change o's mind: $oLx \rightarrow o{\sim}Lx$ (Figure 4.2c). Three, p can start to feel that o is unreasonable, won't take the time to understand the issue, and begins to dislike o: $pLo \rightarrow p{\sim}Lo$ (Figure 4.2d). Any one of these changes would bring the situation back into balance.[3] The situation would be likewise unbalanced if p was in a unit relation with o, which could occur if p believed they were similar to or responsible for o. Instead of pLo, the relationship would be represented as pUo. For example, p could be o's parent, supervisor, or teacher. Unit relationships do not require that p *like* o, but the relationship would be strengthened if there were also a positive sentiment relationship (Heider 1958, pp. 183–184).

Without a change, p will feel stress and tension with respect to this situation. Although not formalized in his notation, Heider (1958) implied that the cognitive tension resulting from an imbalanced triad is in proportion to the importance (strength) of p's sentiment and unit relations (pp. 174–217). For example, the amount of tension in the situation would be great if o was p's best friend, or if p believes strongly about x because they grew up in poverty, or if p believes o is absolutely committed to their like of x. In comparison, the tension would be lower if o were only a passing acquaintance, if p only disliked x because of what they once read in a magazine, or if p knew that o only liked x for superficial reasons.

[3]The third option may seem drastic, but Heider's theory is situational and social psychological; the unbalanced state relates only to x, and only to o as they relate to x. Only with particularly strong sentiments, and in situations where there are no other x's with which p is in relation to o, will $p{\sim}Lo$ colour the entire relationship (Heider 1958, pp. 174–217).

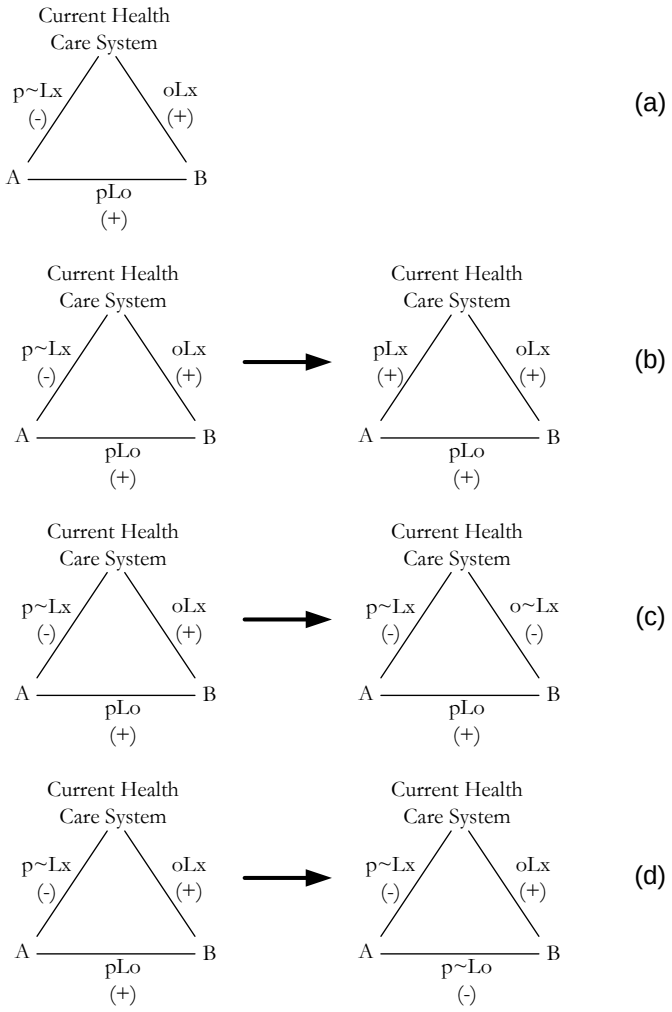


Figure 4.2: Ways in which to balance an imbalanced cognitive triad.

The correspondence between relation strength and the level of cognitive tension is key to the application of balance theory to social expectations.

4.2.2 Application of balance theory to social expectations

Work relationships are unit relationships. At its most basic level, "separate entities comprise a unit when they are perceived as belonging together" (Heider 1958, p. 176). When a coworker, B, is dependent upon A's work, A is in some sense responsible for, committed to, in proximity of, or similar to B. A and B would comprise a unit: pUo. If there is any dependence at all between A and B, there is *at least* one social-psychological situation in which their sentiment and unit relations form a balanced or unbalanced triad: it is with respect to that task interdependency. The dependent, B, needs and therefore *expects* action from A in order to complete their task.

Let A and B be referred to as p and o, and B's social expectation as x. The dependent task-relationship creates a unit relation between A and B: pUo. If we assume that B wishes A to act in away that enables them to complete their task, B will desire their expectation: oLx. If A intends to conform or abide by B's expectation: pLx. The cognitive triad that results, pUo, oLx, pLx, would be balanced (Figure 4.3a). If, on the other hand, A intends to not meet B's expectation: $p{\sim}Lx$. The situation that results, pUo, oLx, $p{\sim}Lx$, is unbalanced (Figure 4.3b). A will feel tension, stress, and discomfort, from the imbalance. There will arise forces encouraging change towards a more balance state.

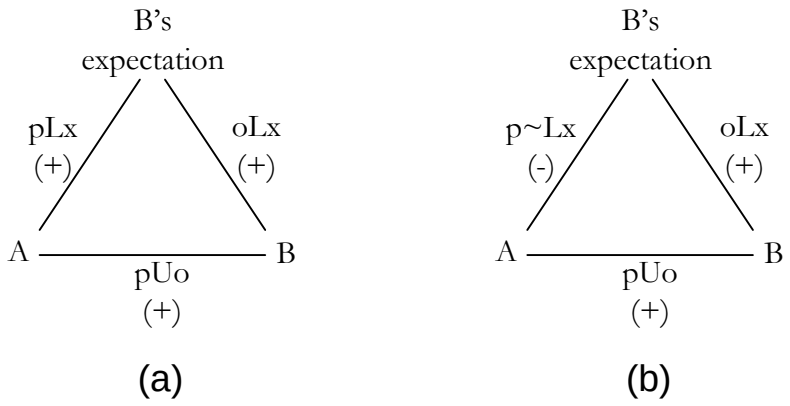


Figure 4.3: Social expectations as a balanced and unbalanced cognitive triad

The imbalance can be resolved in three ways. One, A could start to help B and follow their expectations: $p{\sim}Lx \rightarrow pLx$ (Figure 4.2b). Two, A could convince B that they do not need help from A, or use any other argument to convince B that their expectation is incorrect: $oLx \rightarrow o{\sim}Lx$ (Figure 4.2c). Three, A could arrange to break B's dependence on A's actions, or convince themselves that there is no dependence, or that B's expectation is unreasonable, or that they have met their obligation: $pUo \rightarrow p{\sim}Uo$ (Figure 4.2d). In this third case, B's expectation, oLx, may still exist, but A would experience no tension, stress, or forces towards action; A needs to be in a unit or sentiment relationship with B in order for there to be a balanced or unbalanced cognitive triad. Breaking the unit relation may resolve A's cognitive tension, but it may result in conflict between A and B; B may still believe that their expectation is reasonable and applicable to this situation, but A does not. In this case A's cognitive triad does not exist and experiences no tension and thus no forces towards action. B, on the other hand, still perceives an unbalanced triad, with its resulting cognitive tension. The result may be a perceived amount of "unhelpful behaviours from A" from B's point of view, and a "reasonable lack of action from A" from A's point of view. B would perceive conflict in the situation. A may also perceive conflict, but will not perceive that they were obligated to help in the first place.

The characteristics of the situation will determine the probabilities of each action (Figure 4.2b, c, or d). However, if there is at the least a positive probability of A choosing option b, we should expect that as the level of cognitive tension increases, over a large number of individuals, there will be an overall increase in helpful behaviour from A.

Balance theory explains how dependence or interdependence encourages A towards helping behaviour through the forces produced by B's social expectations. The question now remains, how do changes in the level of dependence or the mutuality of dependence affect those forces? I will first address the effect of low vs. high levels of dependence. The section after will deal with the effects of asymmetric vs. symmetric situations.

4.2.3 Level of dependence: Moving from cell (A) to (C) and from (B) to (D)

The strength of the forces acting on A can change for two reasons: the unit relation between A and B (pUo) can increase in strength; or B's social expectation of A (oLx) can increase in strength.

The unit relation pUo refers to the extent to which A feels responsible for, causes the actions of, belongs to, is in possession of, similar to, or in proximity of, B (Heider 1946). First, increased initiated interdependence has been found to increase the initiator's feeling of responsibility for the dependent's work (Thomas 1957; Horsfall and Arensberg 1966; Kiggundu 1981, 1983). Further, power holders in asymmetric relationships have been found to experience feelings of guilt, irritation and unwanted responsibility for their dependent's well being (Drigotas et al. 1999; Kelley et al. 2003, p. 257). Second, level of dependence, interaction, and contact has been argued and shown to increase the perception of impact on those who are affected by the work (Grant 2007; Grant et al. 2007; Grant and Parker 2009). Perception of impact is the understanding that one causes the actions of, or is causally related to another person. Felt responsibility and perception of impact are two ways in which A perceives a unit relationship with B Heider (1958). As such, it is expected that as level of dependence changes from low to high, whether in asymmetric or symmetric situations, the strength of the unit relation between A and B, pUo, will increase.

The sentiment relation oLx refers to the extent to which B likes, values, desires, or feels strongly about their expectation that A should help. While B could expect help from A "out of the blue," with no real reason, such expectations would carry little weight and would correspond to a low level of tension and few forces towards action on A. In contrast, task-dependent work situations provide a *warrant* and *support* for B's expectation. First, the warrant for the expectation is that A affects B's ability to complete their task. The warrant is

B's legitimate, task-related *need for help*. High levels of dependence create a higher need for help (Rusbult and Van Lange 2003, p. 363), and strengthen the warrant for B's expectation.

Second, the warrant needs to be supported in order to carry weight. Support for B's expectation is provided by social norms. It has been argued that as level of dependence increases, the chance of activating a social norm of reciprocity (Gouldner 1960) and a norm of equity increases (Adams 1965; Smith et al. 1983, p. 655), as do norms of benevolence (Brown and Levinson 1987; Goffman 1971; Gouldner 1960; Flynn and Lake 2008, p. 128), and norms of altruism (Krebs 1970), which lead to helping behaviours (e.g., Bachrach et al. 2006a, p. 194; Bachrach et al. 2006b, p. 1397; de Jong et al. 2007, p. 1627). Empathetic concern has been shown to correlate strongly with helping behaviours (Eisenberg and Miller 1987; McNeely and Meglino 1994) arguably due to norms of responsibility (Berkowitz 1972; Settoon and Mossholder 2002, p. 259).

However, it is not the social norm itself that increases the forces on A to help B. For how can a social norm by itself have any power? A social norm needs to be *in relation to* another person and in the context of a particular situation. B needs to believe that the social norm is activated in that situation. More accurately, A needs to believe that B believes that the norm is activated, since A's cognitive triad imbalance is from A's point of view. The activated norms *support* B's expectation of A's behaviour, oLx. If A does not follow B's expectation, $p{\sim}Lx$, A will experience tension. As the strength of the norms increase, so too does the tension acting on A to resolve the imbalance. This tension gives rise to forces towards change, that is, from $p{\sim}Lx \rightarrow pLx$. Refusing to help B would "be violating an implicit norm of benevolence (Brown and Levinson 1987; Goffman 1971; Gouldner 1960)" (Flynn and Lake 2008, p. 128), or any of the norms that are active in that situation, and would increase the chances for social censure (Burke et al. 1976; Settoon and Mossholder 2002, p.259). To violate the norm would create awkwardness, embarrassment, and other discomfort (tension) for A.

To summarize, high dependence situations create in B the need for help from A. Indeed, without the high level of dependence there would be less warrant for B's expectation. Support for B's warrant is provided by social norms. As level of dependence increases, social norms are activated and strengthen B's expectation of help. Thus, a high level of dependence strengthens the unit relationship pUo and the sentiment relationship oLx which increases the strength of A's cognitive triad imbalance. A stronger imbalance increases the forces acting on the helper to restore balance. The three methods of restoring the balance were described in Section 4.2.2. One method would be to meet the expectation. Finally, without the affordances provided by a high level of dependence, A will simply not have the ability or opportunity to help B (Section 4.1).

Hypothesis 1a: Situations of high dependence afford and motivate helpful behaviours, such that there is a higher probability for helpful behaviours in high dependence situations than in low dependence situations.

There are two arguments that suggest that conflict between A and B will increase as level of dependence increases. The first argument draws upon the power and influence literature. In addition to helpful behaviours, a high level of dependence affords A the ability and opportunity to affect B's task *in general*. This introduces the issue of power; as A's ability to affect B's task increases, so too does A's power over B's task. As (Emerson 1962) noted, power is inextricably related to dependence: "$Pab = Dba$; the power of A over B is equal to, and based upon, the dependence of B upon A" (p. 32). Unbalanced relations, that is, relations of asymmetric dependence, are particularly prone to the effects of power (Emerson 1962, p. 34). Some of A's increased power would be expressed as help towards B (level of dependence affords helpful behaviours), but some of A's power would be expressed as unhelpful behaviour towards B (level of dependence affords more task-related behaviours in general). As a result, heavily dependent individuals often perceive the power imbalance negatively; the dependent feels that the power holder is intrusive, has control over their work, and experiences a mix of "anxiety, insecurity, and mistrust" (Drigotas et al. 1999; Rusbult and Van Lange 2003; Kelley et al. 2003, p. 257). Thus, as level of dependence increases, we should expect the level of conflict within the group to increase as well, particularly in asymmetric task-relationships.

The second argument is based upon the affordance and balance theory approach. As dependence increases both helpful and unhelpful behaviours are afforded. And, as dependence increases, the level of tension produced by A's imbalanced cognitive triad increases. One of the options to reduce that tension is as hypothesized above, A increases helpful behaviours: $p{\sim}Lx \rightarrow pLx$. A second option is that A cognitively justifies a lack of responsibility for B's welfare, or that B's expectation is unreasonable or inapplicable to A: $pUo \rightarrow p{\sim}Uo$. The lack of unit relation between A and B is temporary and only with respect to that particular expectation and social-psychological situation. But the result is an increase in conflict perceived by both B and A. B, for the unhelpful behaviour or lack of helpful behaviour which affects their ability to complete their task. A, for the perception of an increased expectation from B, which is an attempt to affect A's ability to complete their task.

Hypothesis 1b: There is a greater tendency for intragroup conflict in situations of high dependence than in situations of low dependence.

We should also expect that in situations of high dependence, along with an increased affordance and motivation for helpful behaviours, there should also be an increased affordance

and motivation for communication. This is expected because the help seeker would want to communicate their increased urgency, need, and reasoning for their request for help.

> *Hypothesis 1c*: Situations of high dependence would require, afford, and motivate communication, such that there is a higher probability for task-related communication in high dependence situations than in low dependence situations.

Hypotheses 1a, 1b, and 1c are illustrated in Table 4.2.

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of Dependence	Low	(A) lower helping beh. lower communication lower intragroup conflict	(B) lower helping beh. lower communication lower intragroup conflict
		↓	↓
	High	(C) higher helping beh. higher communication higher intragroup conflict	(D) higher helping beh. higher communication higher intragroup conflict

Table 4.2: Effects of a change in level of dependence according to Hypotheses 1a, 1b, and 1c

4.2.4 Mutuality of dependence: Moving from cell (A) to (B) and from (C) to (D)

The unit relation pUo refers to the extent to which A feels responsible for, causes the actions of, belongs to, is in possession of, similar to, or in proximity of, B (Heider 1946). Symmetric dependence has been argued to foster a sense of social responsibility (Krebs 1970) and, ceteris paribus, lead to "higher levels of group cohesion than other task environments" (Seashore 1954; Smith et al. 1983, p. 655), an argument reiterated by later organizational scholars (Lawler and Yoon 1998; Stewart and Barrick 2000). Increased initiated interdependence has been found to increase the initiator's feeling of responsibility for the dependent's work (Kiggundu 1983), but the effect is not only confined to those who initiate the interdependence; required interaction has increased felt responsibility (Turner and Lawrence 1965), as has symmetric dependence (Pearce and Gregersen 1991; Anderson and Williams 1996; Bachrach et al. 2006b; de Jong et al. 2007). Group cohesion, and felt responsibility increase the extent to which A perceives a unit relationship with B. As such, it is expected that as the situation changes from asymmetric to symmetric, the strength of the unit relation between A and B, pUo, will increase.

The sentiment relation oLx refers to the extent to which B likes, values, desires, or feels strongly about their expectation that A should help, or perform actions that allow B to complete their task. There are two arguments that suggest that mutuality should increase the strength of B's expectations on A. The first argument relies on the fact that social norms increase the strength of oLx. Social norms are present in asymmetric situations and are increasingly applicable when moving from low to high dependence (see last section). Symmetric dependence simply increases the effect of these norms. Since the power of norms rests in the shared understanding between A and B as to which social norm is applicable in the current situation, and what the consequences of violating those norms should be, it is expected that in symmetric situations this shared understanding should increase. As shared understanding of norms increases, so too does the tension produced when the norm is violated (Flynn and Lake 2008, p. 129). A similar argument has been made that reciprocality intensifies expectations of social exchange and reciprocity (Anderson and Williams 1996; Settoon and Mossholder 2002, p. 259). In summary, it is expected that as the situation changes from asymmetric to symmetric, A and B will better understand each other's expectations, and better understand the consequences of violating the shared norms underlying those expectations, both of which serve to increase the strength of oLx.

The second argument is derived from the affordances and balance theory approach. Mutuality of dependence means that in the past, and again in the future, A will also be depending on B for help. A better understands B's expectation because A also expects helping behaviour from B. The probability that A will reduce their cognitive tension by breaking the unit relation with B will decrease because they realize that they will be in a similar situation in the future. Therefore, reducing tension through helpful behaviour becomes a more probable action in situations of mutual dependence.

> *Hypothesis 2a* : Situations of mutual dependence afford and increase the motivation for helpful behaviours, such that there is a higher probability of helpful behaviours in symmetric situations than in asymmetric situations.

There are two arguments that suggest that conflict between A and B will decrease in symmetric situations. The first argument draws upon the power and influence literature. As discussed in the previous section, a high level of dependence affords task-related behaviour *in general*. As the extent to which B depends on A increases, A's power over B's task increases, particularly in asymmetric situations (Emerson 1962). However, Emerson also notes that symmetry alters the power relationship. Keeping B's dependence on A stable, and increasing A's dependence on B to an equivalent level creates a symmetrically powerful relationship. While symmetry does not neutralize either one's ability to control the other's task, it does

eliminate the power *imbalance*. Removing the power imbalance reduces the negative effects of asymmetric dependence, yielding "the sorts of benefits that accrue from balance of power, including more placid and positive emotional experience (less guilt, anxiety), reduced use of threat or coercion, less reliance on norms or contractual agreements, and greater stability and congeniality (Baumeister et al. 1993; Fiske 1993; Drigotas et al. 1999)" (Rusbult and Van Lange 2003, p. 355). As a result, as mutuality increases we should expect the level of conflict within the group to decrease.

The second argument is based upon the affordance and balance theory approach. It was argued that in symmetric situations, A will be depending on B for help. As a result, A and B's expectations for help will be more equivalent than in asymmetric situations. This would lower the extent to which A feels that B is attempting to exert control with their expectation, because the reverse situation also occurs. Further, because A has a lower probability of breaking the unit relation as a method of relieving the tension of B's expectation (see Hypothesis 2a), there is a lower probability that B will be disappointed by having their expectations not met (and vise versa when A is expecting help from B). As a result of both arguments, the following hypothesis should be expected:

> *Hypothesis 2b*: There is less tendency for intragroup conflict in symmetric situations than in asymmetric situations.

We should also expect that in situations of mutuality there is less need for communication. Reciprocality and role switching should increase expectations and lower the need for verbal communications, such as asking for help, convincing the help-giver that help should be given, or arguing over help not given.

> *Hypothesis 2c*: There is a lower probability of task-related communication in symmetric situations than in asymmetric situations.

Hypotheses 2a, 2b, and 2c are illustrated in Table 4.3.

4.2.5 The combination of level and mutuality

Hypotheses 1a states that in general, high levels of dependence lead to an increase in the probability for helpful behaviours. Hypothesis 2a argues that in the symmetric situation, A and B will better understand each other's expectations and the consequences of violating the shared norms underlying those expectations, which serves to further increase the strength of oLx. Further, because of the mutuality of dependence, A realizes that they will depend on

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of Dependence	Low	(A) lower helping beh. $\longrightarrow$ higher communication higher intragroup conflict	(B) higher helping beh. lower communication lower intragroup conflict
	High	(C) lower helping beh. $\longrightarrow$ higher communication higher intragroup conflict	(D) higher helping beh. lower communication lower intragroup conflict

Table 4.3: Effects of a change in mutuality of dependence according to Hypotheses 2a, 2b, and 2c.

B at some point in the future, which reduces the probability that they will choose to solve their imbalanced cognitive triad by breaking their unit relation with B and refusing to help. It is proposed that these two effects will compound, such that alone, level of dependence and mutuality of dependence will increase the probability of helpful behaviours, but together they will make an even higher probability of helpful behaviours.

> *Hypothesis 3a*: A high level of dependence will combine with symmetric mutuality of dependence, such that together they will result in a higher probability of helping behaviour than either situations of asymmetry with high dependence, or symmetry with low dependence.

Hypotheses 1b and 1c argue that a high level of dependence will tend to increase intragroup conflict and task-related communication, but Hypotheses 2b and 2c argue that symmetric situations will tend to decrease intragroup conflict and task-related communication. It is difficult to deduce which effect will be more powerful. As a result, no hypothesis is made as to the interaction's effect on intragroup conflict.

Hypotheses 3a is illustrated in Table 4.4.

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of Dependence	Low	(A) lower helping beh. $\longrightarrow$ $\downarrow$	(B) higher helping beh. $\downarrow$
	High	(C) higher helping beh. $\longrightarrow$	(D) much higher helping beh.

Table 4.4: Effect of the combination of level of dependence with mutuality of dependence, according to Hypothesis 3a.

4.3 Group rewards create cooperative structures

Of particular interest to this thesis are asymmetric situations. If more helping behaviours are needed, the theory argues that one should make the task-dependence more mutual. But this may be a difficult change in real work situations. Instead, would it be possible to increase the helping behaviour in asymmetric situations through an increase in reward interdependence? Adjusting performance rewards is typically the easiest way to change work groups, but first we need to understand the effect the change will have (Wageman and Baker 1997, p. 142).

Studies of the effects of interdependence on group performance have found that high interdependence (typically meaning a combination of high level and symmetric dependence) correlates well with performance, as long as it is paired with group rewards (Wageman 1995). In an extensive meta-study, a similar (but weak) fit between reward interdependence and task-interdependence was found by researchers in the Deutsch "social interdependence" tradition (Johnson and Johnson 1989; Stanne et al. 1999). Later experiments confirmed the trend, but contradicted social interdependence theory by finding that it is interdependence that drives helping behaviour; rewards had no independent effect (Wageman and Baker 1997). A replication study confirmed the basic findings, but contradicted the effect of reward interdependence; in this case individual reward interdependence coupled with high task interdependence led to the highest levels of helping behaviour (Allen et al. 2003). As a result, there is currently some confusion as to what role reward interdependence plays in encouraging helping behaviour:

> If it is impossible to decrease the asymmetry in task dependence, one could try to motivate the powerful to pay attention to the powerless by increasing the amount of outcome interdependence [reward interdependence]. This could also reduce the potential attraction of abusing power advantages within a team. Although such an intervention might seem logical and is in line with findings from earlier research into interdependence (e.g., Johnson and Johnson 1989; Van der Vegt et al. 2005; Wageman 1995), future research is needed to establish whether such an intervention would actually have the desired effects (de Jong et al. 2007, p. 1326).

A line of research begun by Deutsch (1949) argues that situations influence how people believe their goals are related and influence how they interact, which in turn affects their performance and group cohesiveness. From the discussion in Section 4.2 we know that as interaction and work group cohesiveness increases, so too will A's perception of a unit relation with B, pUo. How then might situations influence work group cohesiveness and pUo?

Situations can be structured cooperatively or competitively. When structured cooperatively there are positive correlations among member's rewards, and when structured competitively there are negative correlations among member's rewards (Beersma et al. 2003, p. 574). Cooperative situations promote supportive behaviour where group members perceive a shared fate, look out for the interests of the others, and share information. Participants in cooperative situations perceive that they can reach their goals only if the others in their group also reach their goals. On the other hand, competitive situations motivate group members to withhold information and impair the progress of others in order to gain an advantage. Participants in competitive situations believe that, if they are competitively linked with others in their group, when others attain their goals it reduces their own ability to reach their goal (Stanne et al. 1999, p. 134).

From social interdependence theory, we should expect that increasing reward interdependence (from individual to group) should increase A's perception of unit relation with B, pUo. It should alert A and B that they are in a cooperatively structured situation, and thereby increase A's understanding of B's social expectation, oLx, and A's understanding of the social norms supporting B's expectation. As a result, the tension and the forces acting on A towards helping behaviour and communication should increase. With the increase in helping behaviour and intragroup cooperation, group rewards should reduce the overall intragroup conflict.

It is expected that this effect is simple and will not interact with either level or mutuality of dependence. In all conditions it is expected that the addition of group rewards should increase helping and communication, and reduce conflict. Therefore the following hypotheses are presented straightforward without reference to the previous 2x2 matrix organization that hypotheses 1 and 2 used.

> *Hypothesis 4a*: Group rewards signal cooperative situations, such that there is a higher probability of helpful behaviours in situations with group rewards than individual rewards.

> *Hypothesis 4b*: Group rewards signal cooperative situations and lead to less intragroup conflict than individual rewards.

> *Hypothesis 4c*: Group rewards signal cooperative situations and lead to more communication than individual rewards.

Chapter 5

Experiment

This study is concerned with three aspects of task structure: mutuality of task dependence, level of dependence, and reward interdependence. The hypotheses discussed in Section 4.2 predict how different task structures would affect helpful behaviours, intragroup conflict, and task-related communication between interdependent dyads. The general theoretical argument is that the manipulations of task structure would create stronger expectations from the helpee, which would produce tension in the helper, which would motivate the helper towards performing helpful behaviours. This chapter will describe the experimental task, how the independent and dependent variables were operationalized, the procedure, and the results.

5.1 Previous experimental tasks

An experiment was needed that operationalized mutuality of dependence, level of dependence, and reward interdependence such that each could be manipulated while keeping the fundamental task the same and while not affecting the other manipulations. During the development of this task I examined the literature for studies that have used experimental tasks to investigate interdependency. In the next section I will review these past studies with an eye to how well the experimental tasks were able to manipulate these different aspect of interdependence.

5.1.1 Problems manipulating level and mutuality of dependence

Previous experimental studies in the organizational behaviour field have used variations on group decision-making tasks, such as: copy-editing manuscripts and catching errors in APA-style references (Wageman and Baker 1997; Allen et al. 2003); a performance-appraisal task

recommending merit bonuses based on written descriptions of employees (Saavedra et al. 1993); or a card sorting task requiring three person teams to arrange stacks of shuffled cards into predetermined sequences (Bachrach et al. 2006b).

These experimental tasks have the benefit of face validity; readers can readily visualize how a pair working together on a copy-editing task is similar to many of the task relationships found at work. Unfortunately sometimes what is gained in face validity is lost in fine control over the manipulations. For example, consider level and mutuality of interdependence (Section 3.1.5).

Bachrach et al. (2006b) use a card sorting task and create two level of dependence conditions, low and high. Participants were divided into groups of three and given three stacks of cards. In the low task interdependence condition team member A sorted one stack of cards individually, after which team member B sorted the second stack, and then member C sorted the third stack. "These individuals were not allowed to physically aid in the processing of another member's cards" (p. 1398). Unfortunately it is unclear how the high interdependence condition worked, due to ambiguity between the description (p. 1398) and the graphical representation of the interdependency manipulations (p. 1405). Most likely the authors allowed all three team members to work together to sort the first stack into its required sequences, after which the team moved to stack two, then finally to stack three. In this condition the three team members were allowed to physically help one another. The authors summarize their manipulation:

> These constraints required that members in the low task interdependence condition work on their own stack of cards in relative isolation, whereas group members in the high task interdependence condition were required to work on a communal stack of cards in conjunction with one another (Bachrach et al. 2006b, p. 1398).

The authors had confounded level and mutuality of dependence: the "low task interdependence" condition is a low level of symmetric dependence, while the the "high task interdependence" condition is a high level of symmetric dependence. The authors have argued that organizational citizenship behaviour (in this case task-related helping behaviour) can vary from low to high over the low to high levels of interdependence. The authors predicted that in task situations with low interdependence, moving from low levels of OCBs to high levels of OCBs would decrease the groups performance, as opposed to the high interdependency condition, where moving from low to high levels of OCBs would increase performance. In short, interpersonal task-related help was predicted to do more harm than good in a task situation with low interdependence. However from the quote above, and the manner in which

the authors have constrained the behaviour of their participants, it would not appear to be possible to have *any* helping behaviour in the low interdependence condition.

Helpful behaviours in this experiment were observed and rated by graduate student observers using a standard seven item helping scale (Podsakoff et al. 1997) . Curiously the authors do report a mean of 4.05 out of 7 ($SD = 0.87$) helping in the low interdependence condition, as compared to a 4.81 ($SD = 0.95$) in the high interdependence condition. Why is there helpful behaviour when it would appear to be constrained out of the situation? The answer lies in how the participants in the experiment are interdependent, and this affects the ability of the experiment to manipulate level of dependence without affecting the task.

The two levels of interdependence do not involve the same task or the same type of interdependence. According to the description of the experiment, there is no physical interdependence between team members in the low interdependence condition. There is no resource or work output sent, nor is there any needed by any of the members in order to complete their task. What must have been sent and received is information about how to best complete the task—although it is impossible to be certain of this, because the authors did not provide an example or what was or was not considered a helpful behaviour. Assuming this, the low condition is interdependent with respect to information, while the high condition is interdependent with respect to information as well as physical behaviours. In the first condition it is an individual task with informational help from teammates. In the second condition it is a group task, with all that group-work entails when sharing physical space and resources to complete a task—who holds the cards, who moves the cards, and the numerous other roles that appear in teams.

Manipulating informational interdependency becomes more complicated when we consider that the interdependence varies as a function of the complexity of the predetermined card sequence task-goals, the source card stacks, and the intelligence of the participant. To summarize the card sorting task, the teams were judged on accuracy (completing the sequences correctly and in the proper order) and time, while they competed for a share of a $1500 prize. The teams were given three shuffled stacks of cards, each of which was made from three different decks, coloured black, green, or red. The team needed to create a number of sequences of ascending cards (ace through king) with specific alternating patterns of suits and deck colours. An example sequence was Ace of Spades in black, 2 of Clubs in green, 3 of Diamonds in red, and so on. The sequences and possible combinations of cards were deliberately complex so that some of the participants would be confused about what to do and how to do it in the least amount of time.

Even within the low condition, the amount of informational interdependence in the card sorting task varied on the extent to which a participant was confused about what to do, could

	General Errors	Errors of the type trained on	Errors of the type not trained on
Low task interdependence	33%	67%	0%
Medium task interdependence	33%	33%	33%
High task interdependence	33%	17%	50%

Table 5.1: Task interdependence manipulations from (Wageman and Baker 1997, p. 152)

not understand the best process to go through in order to complete the task, or forgot a condition of the experiment (the violation of any condition nullified the team's eligibility to win the prize). For a suitably complex task there would be informational interdependence—a participant would need help (communication) from their teammates to figure out what to do and how to do it quicker. But this also depended on the cognitive ability of the participant—if they understood the task and how to complete it best, there would be little if any informational interdependence. In short, this particular form of informational interdependence is difficult to manipulate, because it depends on cognitive ability, motivation to focus on the task, and other mercurial individual differences. It would be possible, for example, for team A to have no informational interdependence because the individuals each understood the problem, and for team B to have a very large amount of interdependence because they didn't pay attention to the task instructions. But both of these teams would officially have been in the low interdependence condition. The authors themselves admit that this was a problem: "although there were significant differences in task interdependence across the two experimental conditions, activities in the low interdependence condition were not completely independent (e.g., task interdependence in the low condition was rated as 4.15 on a 7-point scale)" (Bachrach et al. 2006b, p. 1401), as compared to a 5.94 in the high condition (p. 1399). As a result of the difficulty isolating and manipulating their interdependence condition, the authors did not find their hypothesized negative relationship between helping behaviour and task performance (pp. 1400-1401).

The experimental task used by Wageman and Baker (1997) and Allen et al. (2003) allows more careful control over interdependence, and although the manipulations may not be precise enough to vary the actual levels of interdependence, it could be easily adapted to manipulate mutuality of dependence. These studies formed teams of two participants who worked together to correct mistakes in a six-page article describing a psychology experiment. Errors were of three types: general grammatical and spelling errors; errors in citation format; and errors in tables, headers, and equations. Team member A was taught how to correct citations according to APA style, and member B was taught how to correct tables, headers, and equations in APA style. The conditions of low, medium, and high interdependence were created by giving the team members a different percentage of each of the three error types. Table 5.1 presents the distribution of errors for each of the interdependency conditions.

As interdependence increased, a participant was given more errors for which their teammate was trained. This required the participant to consult their teammate in order to correct the error. The authors observed that the error was solved through different communications and behaviours, such as "sharing each others' tip sheets; teaching each other what they learned during the training session; trading articles; and discussing how to approach the task" (Wageman and Baker 1997, p. 154).

The authors note that because "General Errors" involve grammar and spelling mistakes, there was always an element of interdependence between the two team members. This is to be expected, considering that it is labeled "low task interdependence" condition and not "no task interdependence."

In order to judge the suitability of an experimental task the question becomes, how precise is the level of dependence manipulation? Are groups in the Low condition at a similar level of dependence? Are groups in different conditions experiencing a different amount of dependence? It is possible that due to similar problems found in the Bachrach et al. (2006b) experiment, the interdependence manipulation may not have produced the desired actual level of dependence, which may help explain the weak correlation between interdependence and helping behaviour (Wageman and Baker 1997, p. 154).

However, a strength of the copy editing task is its ability to be adapted to manipulate mutuality of dependence. In the original experimental task the two teammates had a perfect symmetry of dependence. One team member was trained to fix citation errors, and the other was trained to fix errors in tables, headers, and equations. Team member A was faced with a situation where they needed B's knowledge to fix a certain percentage of errors, and B needed A's knowledge for the same percentage of errors. The task could be changed to vary the percentage of errors, such that A did not require B's knowledge (0% of errors of the type not trained in) but B required A's knowledge (perhaps 50% of errors of the type not trained in). In this manner it would be convenient to create asymmetric dependence.

The experimental task used by Saavedra et al. (1993) was designed to manipulate mutuality of dependence. Participants were divided into groups of three to evaluate the performance of hypothetical workers, based on reading a summary of their behaviour. The teams were asked rate the set of workers on a number of scales, then use the result and a lookup table to determine what the worker's merit increase would be. The team's output was a merit evaluation sheet. The authors note that there was a unique and correct evaluation for each worker's summary, based on the words used to describe the worker. Each team's performance would be evaluated based on the number of workers they could evaluate and the correctness of each evaluation.

The teams were randomly assigned to four sequence conditions: pooled, sequential, re-

ciprocal, and team. The pooled condition was essentially an independent condition: a stack of worker summaries was placed in the centre of the table and each team member would select a summary, rate the worker, look up the worker's appropriate merit increase, fill out their merit evaluation form, and select a new summary. Each team member did this sequence independently. The teams in the pooled condition were considered a team because they were measured as a group and given a group-level reward.

In the sequential condition the task for evaluating each worker's summary was split into three parts. Each part was one third of the total amount of work. Each team member was randomly assigned to be the A, B, or C role. The A role took the worker's summary from the stack, completed the first part of the work and handed the summary and merit evaluation sheet to B, then took the next worker's summary from the stack. B completed their task and sent the materials to C, who completed their task and placed the finished merit evaluation sheet on the finished pile. The group received a group-level performance measurement and reward.

The reciprocal and team conditions used the same distribution of work: role A was the support who would take the worker's summary and fill out the preliminary information of the merit evaluation form. Role B and C would work together to rate the worker, while A would assist B and C by looking up the appropriate merit bonuses in the lookup table. The difference between the reciprocal and team condition was that the groups in the team condition were allowed to decide on how they would organize themselves, while the reciprocal condition was prescribed these roles in the experiment task instructions. The authors note that 79% of the groups in the team condition arrived at this division of labour on their own (Saavedra et al. 1993, p. 65).

There are three points to note about the Saavedra et al. (1993) experimental task. First, the authors stressed to the participants that there were correct evaluations of the worker's summary paragraph, based on the words used in the description, and that these words and their values were invariant across all summaries. But the participants only realized the correctness of their merit evaluations after the experimenter took the merit evaluations, marked them, and returned the feedback. Feedback was given after a 10 minute practice trial, and the 10 minute experiment trial. Thus, the participants were unsure of the correctness of their evaluations during the task itself. Second, because of the lag-time in correctness feedback, the members in the sequential and reciprocal/team conditions were interdependent not in the correctness of their work, but in the timing of their work. In the sequential condition, for example, it did not matter to B how well A did their job, it only mattered how quickly A could finish their section of work and hand off the merit sheet to B. To be clear, timing is certainly a component of interdependence, but it is different from correctness. Third, the task was designed in a way that would make it difficult to introduce level of dependence as

a manipulation. For example in the sequential condition, it is difficult to imagine how to make B *more* dependent on A. If A were given more work, or if A were given more important work, it could certainly delay B's work. But B's work wouldn't become more or less difficult based on A's ability to complete their task. B would still be able to complete their portion of the task regardless of how A performed, and regardless of the amount of work or the importance of A's portion of work. This is a consequence of the second point above: without an experimental operationalization of correctness (See Section 3.1.5), it would be difficult to change the extent to which B depends on A, or C depends on B. For these reasons I felt the Saavedra et al. (1993) experimental task was unsuitable for this study.

5.1.2 Problems measuring helpful behaviours

Past experimental studies which have used helpful behaviours as a dependent variable have been unable to measure it objectively. It is unclear whether or not this is because the "helpful behaviour" concept has its roots in observational and survey-based methods, many of which are from the OCB literature (Podsakoff et al. 2000). But the result is that past experimental studies have relied on third party observer ratings and group self-assessments of helpfulness.

Bachrach et al. (2006b) used graduate students working in pairs to observe and rank the amount of OCBs between team members. After the teams completed their tasks, the graduate students used a standard seven item helping scale from the OCB literature (Podsakoff et al. 1997). The average interrater reliability of the graduate student's judgements was .69 (p. 1399). The problems of subjectivity in observer ratings cannot be avoided, but Bachrach et al. (2006b) compound the problem by not providing an example of what is considered a helpful behaviour and what isn't. This is a particularly harmful omission because the study's form of informational interdependence (Section 5.1.1) is difficult for readers to visualize. For example, how were different behaviours weighted? How important was it to give a small practical instruction such as, "Move this card there," versus an instruction that triggered a greater conceptual understanding of the task as a whole? Suppose a member misunderstood the instructions, and a teammate said, "No, you're supposed to build a sequence of cards using the pattern on the sheet, it doesn't matter how you get there, just speed matters." Unfortunately there are no examples of what constituted a helpful behaviour, how it was coded, and how that translated to the observer's rankings.

There are similar problems with the Wageman and Baker (1997) and Allen et al. (2003) task. Helpful behaviours were measured in two ways. First, one of the experimenters observed the copy-editing teams through a one-way mirror. At the end of the task the experimenter rated the team on a scale from 0 (did not cooperate at all) to 4 (cooperated a

great deal). Second, the team members were given a post-session questionnaire. Four questions measured how much the subjects believed they had cooperated with their teammates (p. 150). As in the Bachrach et al. (2006b) study, it is difficult to compare different helpful acts when they are informational. Suppose a teammate had the question, "Should the conference name or the paper's title be in italics when citing a conference presentation?" Would this be considered more or less helpful than simply passing the cheat sheet which had all the APA rules for formatting citations? Although, to be fair, this is an unavoidable problem with any observational-based measure.

5.1.3 Requirements for an experimental task

A new experimental task needed to satisfy the following seven conditions.

1. The task needed to be executed at low and high levels of dependence and still remain the same.

2. The task needed to remain the same given an individual and group reward structure.

3. The task needed to remain the same whether the participants were in an asymmetric or symmetric dependence. This is a particularly difficult condition to meet, as can be seen in the discussion of the Saavedra et al. (1993) merit evaluation task. Most complex tasks are changed when a participant works on them in isolation or with other people; they are simply no longer the same task.

   These first three conditions should hold, otherwise it would be difficult to separate the effect of the manipulation from the effect of the different task.

4. The task's level of dependence needed to depend not only on time, as in the Saavedra et al. (1993) task, but also to whether or not the task was completed correctly. The task needed to model the situation described in Section 3.1.5, common in software engineering and other industries, where a task can be completed to varying levels of quality. The participants needed to be able to complete the task to specification, and then have the opportunity to put in more effort to do a better job. Participants needed to be able to perform helpful behaviours, at a well understood cost to themselves. These clearly defined, optional, helpful behaviours would model the effort, time, and resources it takes an employee to go above and beyond the call of duty (see pp. 77–78).

5. The experiment needed to have an objective, quantitative, behavioural measure of helping behaviour.

6. The participants needed to be well aware of the precise cost of each of their actions, and the effect this cost would have on their ability to reach their goal and receive their reward. No information about the experiment was hidden from the participants. In addition, participants needed to be tested on their understanding of the rules and the costs and effects of their actions. This was accomplished through the use of control questions, which participants were required to answer correctly before participating. This and the previous two items are informed by recent methodological advances in behavioural economics (Herrmann et al. 2008a,b; Hertwig and Ortmann 2001, 2008a,b; Ariely and Norton 2007).

7. The task had to be simple enough that little to no training was required. This was intended to remove training effects, physical aptitude, and cognitive ability as confounding variables, which have been noted to obscure the results of group task experiments (Allen et al. 2003, p. 732).

5.2 The card game task

A new card game task was developed in order to satisfy the conditions above. The card game was designed to simulate a work situation in which a worker could complete their task to varying degrees of correctness. At the beginning of the experiment participants were arranged in dyads and randomly assigned the title of "Player A" and "Player B." The game consisted of 20 rounds. Depending on the condition, in each round one participant was the sender of cards and their partner was the receiver of cards. Each player had a hand that could hold two cards. The sender (e.g., A) was given a goal number, such as 8, and drew playing cards until the sum total their hand met or exceeded their goal (e.g., 4 & 4, 3 & 5, or 4 & 5). Upon reaching their goal, A sent their hand to their partner, B. Player B's task was to take the cards sent by A and add their own hand in order to reach their goal, such as 22. If B was able to reach their goal, their team would have successfully completed one round. If B failed to meet their goal, the team would receive a "failed round," the consequences of which depended on the condition (Section 5.2.3, p. 116). Drawing a card had a cost of \$1, and the players needed to meet or exceed their goal while staying under their budget. For example, a budget of \$24 meant the player could draw 24 cards maximum.

The deck from which the players drew cards changed based on the number of cards that player had already drawn that round. At the beginning of a round players would draw aces, 2's and 3's, and as they drew more cards they were more likely to get higher numbered cards. The card distribution is given in Table 5.2. The card distribution was designed to simulate effort and a dynamic where "more effort leads to better quality work," where higher valued

hand signifies more effort or better quality work. If the player decided to do only the bare minimum of work required to meet their goal, they could stop drawing cards when they reached their target. This would be considered a minimally "correct" hand for the sender, as they had reached their goal. There was an element of randomness, but it was constrained, such that if a player wanted to send a higher hand to their partner, they would need to draw more cards at a higher cost.

	Percent chance of getting this card during Draw # X						
Draw #	60%	25%	15%	Draw #	60%	25%	15%
1 to 5	Ace	2	3	21 to 25	5	6	7
6 to 10	2	3	4	26 to 30	6	7	8
11 to 15	3	4	5	31 to 35	7	8	9
16 to 20	4	5	6	36 to 40	8	9	10

Table 5.2: Card distributions

Players were encouraged to focus their attention on their cost for two reasons. One, their budget modeled their total amount of time and effort they could spend on the task, and served to make helpful behaviours personally costly (Bergeron 2007). Two, they were competing against other participants in the same condition and same role (A's vs. A's, and B's vs. B's) for $20 prizes—since there were 8 conditions, and two roles per condition, there were 16 prizes in total. The participant with the lowest total cost would win the prize.

It was made clear in the instructions that the receiver was using the sent hand and adding to it in order to complete the group's task. For example, if A sent their hand worth 8, and B's goal was 22, B would need to get a hand worth 14 (B's goal, minus the sent hand) in order to complete their task. Thus, the receiver's level of dependence was contingent on the task goal (e.g., a goal of 24 vs. a goal of 22), their task budget (e.g., a budget of 30 vs. a budget of 20), and the behaviour of the sender. For example, if A instead had instead sent a hand worth 12, and B's goal was 22, B would have only needed to get a hand of 10 in order to reach their goal. Depending on B's budget, the difference between A sending 12 vs. 10 could have been the difference between B succeeding or failing at their task.

5.2.1 Design, research participants and procedure

The experiment took place in a 40-seat computer lab. The computer lab was designed like most student computer labs: to put the most number of computers in the least amount of space. Following established behavioural economics procedure, in order to minimize the interpersonal social factors that might influence behaviour, care was taken to keep partners

as anonymous as possible (Herrmann et al. 2008b; Camerer 2003a). Styrofoam dividers separated the computers, such that a participant would have to lean far back and look around in order to see their neighbour's screen. The styrofoam dividers had the side benefit of creating a "serious" situation for the students when they were allowed into the room. As is standard in behavioural economics experiments, participants were randomly assigned a role, and the roles were distributed such that partners would not be seated near to each other in the lab. However it is impossible to completely remove all social influence in such an experiment: the participants were drawn from the same research pool and the participants knew that someone in the room was their partner.

A total of 182 participants were recruited from a research pool of second year business undergraduate students (42.8% female, average age $= 20.2$ years, average number of years in undergrad $= 2.2$, average number of years of full-time work experience $= 1.0$). Participants received course credit for participation, and 16 individuals received performance-based prizes of $\$20$. Upon entering the lab, students sat at their computer and were instructed not to speak with the other participants. They were randomly assigned to one of 8 conditions described below, and shown a 9-minute training video (an in-browser "screencast") specific for their condition. After finishing the training video they answered a set of six control questions designed to test their understanding of the task and the costs and effects of helping behaviour (Herrmann et al. 2008b). The script for the screencast with screen captures of the video are presented in Appendix B. The control questions are presented in Appendix Appendix C. The control questions were designed to ensure that participants understood that drawing extra cards was optional, and that helping their partner by drawing extra cards was costly and would prevent them from winning the prize. All participants were required to answer the control questions correctly before entering the game.

The computer program was designed to be as simple as possible while still giving the feedback required to keep track of costs and the number of successful rounds. Figure 5.1 presents a screenshot of the computer program written to run the experiment. The players are given buttons to draw a card, discard the card they've drawn, move the card to their hand, discard a card they have in their hand, or give up the round. The players are given feedback on their cost so far this round, their budget for this round, their total and average cost for the game as a whole, and the number of successful rounds out of the total rounds they've played. When they've met their rounds goal the "Send Cards" button is activated. The right side of the computer program acted as an instant messaging system which was activated after 10 rounds of play (see the discussion of the communication manipulation, p. 117).

In order to test the hypotheses in Section 4.2, 91 dyads were randomly assigned to eight conditions in a 2 (low vs. high level of dependence) $\times$ 2 (asymmetric vs. symmetric dependence) $\times$ 2 (individual vs. group reward) completely crossed factorial design. A 2 (no

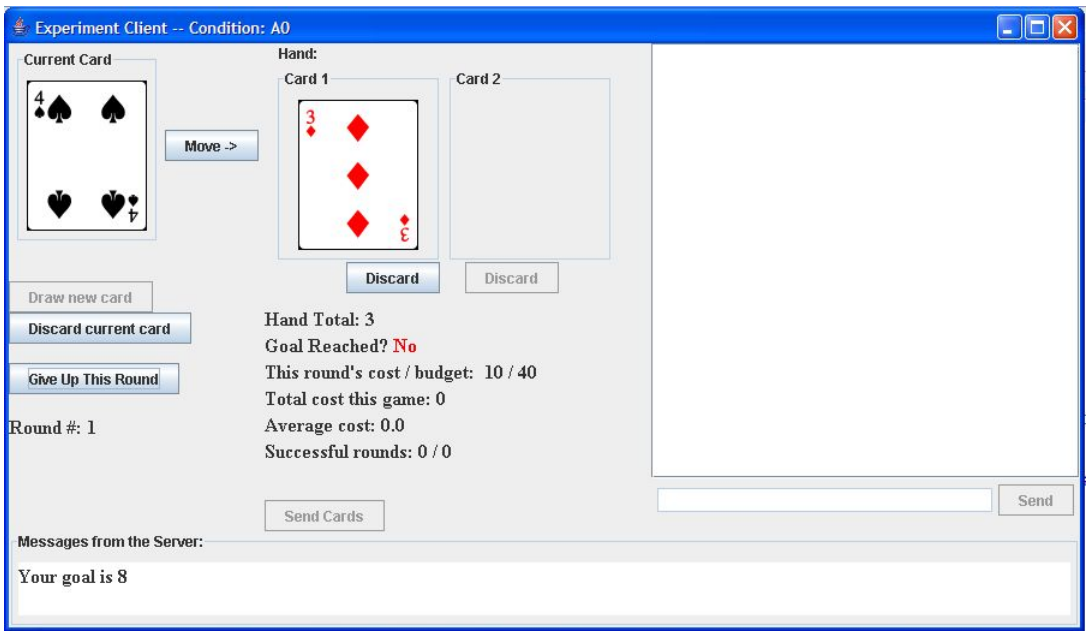


Figure 5.1: Screen capture of experiment program.

communication vs. communication) within-subjects condition was used to create a 2 $\times$ 2 $\times$ 2 ($\times$ 2) mixed factorial design.

5.2.2 Dependent Variables

Helpful Behaviours

The behavioural measure of helpfulness was the number of cards that a player drew in excess of their goal. The participants knew, through the training videos and the control questions, that drawing more cards would be helpful by making it easier for their dependent to reach their goal. For example, if A's (the sender's) goal was 8, and had drawn a 3 and a 5 in 12 draws, their cost for that round would have been 12. If they then decided to send a higher hand to their partner B (the receiver), A would draw more cards, perhaps drawing two cards and getting a 5. Their hand would then be worth 10, their cost would have been 14, and they would have performed two helpful behaviours.

Helpful behaviours could only be performed by one member of the group per round: the sender. In that round the receiver could not perform helpful behaviours for their partner because the receiver's hand was not sent to their partner (see Section 5.2). Therefore the unit of analysis was the group, which decreases the degrees of freedom but is the only meaningful way to compare number of helpful behaviours between conditions. Additionally, it would be difficult to use an individual level of analysis because Player A and B's behaviours are not

independent (Kashy and Kenny 2000).

Communication

Communication was measured as the number of task-related communications between partners. Because communication was free-form through an instant messenger style interface, the messages were unstructured and not always task-related. The communications needed to be analyzed and placed in one of two categories: task-related and non-task-related. Task-related communications included any of the following: related to understanding partner's situation; a request for certain behaviour; agreeing to a request; related to understanding the game; related to understanding the individual vs group reward conditions; or related to understanding the competition and/or how to win it. Non-task-related communications included everything else, which was usually such messages as: introductions; talking about courses; complaining about the experiment; talking about plans for the weekend; and so forth.

The metric used to measured communications was the number of words sent. This was chosen over the number of messages. The number of words was chosen because counting only the number of messages sent could misrepresent the importance of each message—it was observed that many messages were one or two word responses (e.g., "ok" or "sure thing"), while a few others were 20–30 word sentences, and that these messages should not be weighted equally. This introduces the problem of weighting a 10 word message as twice as meaningful as a five word message. The alternative would have been to individually code each message and rate it in terms of importance on a scale, but that would have introduced a level of bias and subjectivity that I wanted to avoid. Neither option was perfect, but this solution was chosen because it adds some weight for meaning while keeping the measure as objective as possible.

Intragroup conflict

Hypotheses 1b, 2b, and 4b predict that the level of conflict in a relationship will depend upon the level of dependence, mutuality of dependence, and reward interdependence. Intragroup conflict was assessed using questionnaire items rated on 5-point Likert scales in which 1 = *strongly disagree* and 5 = *strongly agree*. Conflict was assessed using seven items adapted from Lee et al. (1991) and Saavedra et al. (1993) to measure intragroup conflict: (a) "There was a lot of tension among my partner and I"; (b) "My partner and I never interfered with each other's work [reverse scored]"; (c) "My partner and I got along with one another [reverse scored]"; (d) "Given the way my partner performed their role I often felt frustrated"; (e) "I found myself unhappy and in conflict with my partner"; (f) "My partner, who I depended on

to get my job done, often let me down"; and (g) "I found myself in conflict with my partner because of their actions (or lack of actions)."

I factor analyzed this set of items using a principle component analysis, and the results showed (unexpectedly) two factors accounting for 58.7 % and 14.6 % of the variance. The second factor was question (b): "My partner and I never interfered with each other's work." Question (b) correlated poorly with all other questions, with correlations ranging from .037 to .21. Upon further inspection, it would appear that this question did not make sense to the players in this experiment; there is no way for a player to "interfere" with their partner's work because the player's task-related behaviours are constrained to drawing cards, not drawing cards, and passing their hand. With such low correlations, this question was dropped from further analysis.

The revised set of 6 questions resulted in one factor accounting for 68% of the variance. The KMO test for sampling accuracy was .82, which is considered great (Kaiser 1974), indicating that the sample size is adequate for factor analysis. Similarly, Bartlett's test of sphericity is significant ($\chi^2(15) = 402.45, p < .001$) indicating that factor analysis is appropriate (Field 2009, p. 660). The reliability (Cronbach's alpha) for the conflict scale was .90 and the item loadings ranged from .60 to .91. The group-level measure of conflict was the average of A and B's conflict measure.

5.2.3 Independent Variables (Experimental Manipulations)

Level of Dependence

Two level of dependence conditions (low, high) could be created in a number of ways, such as: increasing the goal of the receiver, reducing the goal of the sender, decreasing the budget of the receiver, changing the card distribution for the receiver or the sender, or increasing the cost of cards for the receiver or dependent. I chose to decrease the budget of the receiver, as it was the most direct and easiest to understand method of increasing the receiver's dependence on the sender. As the receiver's budget decreases there is a greater chance that they will not be able to reach their goal before they run out of budget.

Table 5.3 shows the goals and budgets for the sender and receiver in each of the 8 conditions. Note that the sender and receiver's goal and budget only changed between the low and high dependence conditions. In the low dependence condition the sender's goal was 8, their budget was 40; the receiver's goal was 24, their budget was 37. In the high dependence condition the sender's goal was 8 with a budget of 40 (no change), but the receiver's goal was 24 with a budget of 22 (budget was reduced by 15). Therefore, the task itself does not change between conditions, only the receiver's budget changes. Given the card distribution

(Table 5.2), it is difficult for the receiver in the high interdependence condition to complete their task if the sender sends only the bare minimum hand of 8—the sender will run out of budget before they can reach their total goal of 24. Thus, in order for the receiver to complete their task they are dependent on the sender for help.

Crucially, the sender's budget does not change—it is 40 in both low and high dependence conditions. This means that there is no experimental constraint on the sender's ability to help the receiver in either condition.

	Goal, Budget Pairs: (sender goal, sender budget); (receiver goal, receiver budget)			
	Individual Reward		Group Reward	
	Asymmetric	Symmetric	Asymmetric	Symmetric
Low Dependence	(8, 40); (24, 37)	(8, 40); (24, 37)	(8, 40); (24, 37)	(8, 40); (24, 37)
High Dependence	(8, 40); (24, 22)	(8, 40); (24, 22)	(8, 40); (24, 37)	(8, 40); (24, 22)

Table 5.3: Goals and budgets for each experimental manipulation

Mutuality of dependence

Two mutuality conditions (asymmetric, symmetric) were created by varying who depended on whom. Recall that at the start of the experiment one participant in the dyad was given the name Player A, the other Player B. The asymmetric condition was created by making A the sender and B the receiver for every round. For all 20 rounds B depended on A, and A did not depend on B at all. Player A would send their cards to B, and B would try to reach their goal.

The symmetric situation was created by alternating between the two: In round 1, A was sender and B was receiver; in round 2, B was sender and A was receiver; in round 3 A was sender and B was receiver; and so forth. In this way A and B relied on each other an equal amount, affording them the opportunity to help or not help in kind.

Reward interdependence

Two reward conditions (individual, group) were created by changing how a "failed round" affected the player's costs. Recall that the participants were competing for $20 prizes that would go to the participant with the lowest overall cost at the end of 20 rounds. Participants in the individual reward condition were instructed that only their personal cost mattered. Their partner could fail to reach their goal, and their team could fail to complete every round, but only their own cost would be counted. For example, in this condition a Player A could

draw the minimum number of cards possible to reach their goal, send those cards to their partner, and they would have a good chance or winning their prize. Player A's cost would not be affected if their partner could not reach their goal and their group received a "failed round."

Participants in the group reward condition were instructed that both their individual cost and their group success mattered, in the following way: their personal cost would increase by \$15 for every round their group failed. For example, in this condition if a Player A drew the minimum cards possible to reach their goal, but in doing so their partner could not reach their goal, both Player A and Player B's cost would increase by \$15. In this way the sender's performance (cost) and their reward was affected by their partner's ability to complete their task.

Communication

Two communication conditions (no communication, communication) were created by allowing communication through an instant messenger style window in the computer card game. The instant messenger window was greyed-out (not working) during the first 10 rounds of the experiment. At the beginning of the 11th round the instant messenger became active and the players were shown a dialog window alerting them of the change. The participants were notified during the training screencast that they would be allowed to communicate after the 10th round, and one of the control questions quizzed them on this condition.

Although direct typed communication was restricted for the first 10 rounds, partners likely communicated through two forms of behavioural communication. One, the game software notifies both partners of a failed round if the receiver is unable to reach their goal. Recall that this would result in a cost of \$15 for both players in the group reward condition, and even though there is no additional penalty in the individual performance measurement condition, the players are still notified that they failed a round. Two, those players in the reciprocal measurement condition could communicate behaviourally through the cards that they sent to each other in alternating rounds. Recall that the sender and receiver roles alternate between Player A and Player B in the reciprocal sequence condition, and if one of the players was unhappy with the cards their partner sent the last round, they could send a lower hand this round in retaliation.

5.3 Results

The analysis consists of two parts: one, a test of the within subjects effect of the communication manipulation; and two, tests of hypotheses 1a–4c. In all cases results are presented at

the group level of analysis.

The means and standard deviations for the dependent variables helpful behaviours, task-related communication, and intragroup conflict across levels of dependence, mutuality, and reward are presented in Table 5.4. The Pearson correlations among these variables appear in Table 5.5. A more thorough understanding of the results may be gained by seeing how many dyads performed a certain number of helpful behaviours per condition, which is presented in Figure 5.2. Before testing the hypotheses, a mixed ANOVA with the within-subject manipulation of communication (no communication vs. communication) was run. The only dependent variable for which communication would have a before/after affect on would be the number of helping behaviours, as task-related communications were only allowed in second communication condition (obviously), and intragroup conflict was assessed only once at the end of the experiment. The results of the mixed ANOVA are presented in Table 5.6.

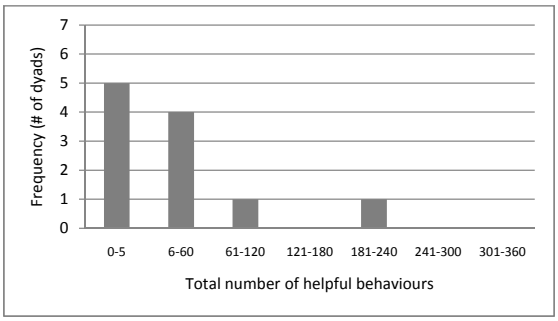
There was a significant main effect of the communication manipulation on the amount of helpful behaviours, $F(1, 83) = 71.69, p < .001, \eta^2 = .46$. Specifically, the overall average number of helpful behaviour before communication was allowed was $M = 25.93, SD = 29.66$, and after was $M = 66.67, SD = 58.69$. There was a significant interaction effect between the communication and level of dependency manipulations, $F(1, 83) = 12.83, p < .001, \eta^2 = .134$, illustrated in Figure 5.3. Allowing communication increased the number helpful behaviours in both the low and high levels of dependence conditions, but the effect of communication was larger in the high dependence condition (no comm: $M = 37.53, SD = 34.80$, allowing comm: $M = 95.93, SD = 53.52$) than in the low level of dependence condition (no comm: $M = 14.59, SD = 17.46$, allowing comm: $M = 38.04, SD = 48.85$).

The communication by level interaction was significant, but in the same direction, which makes reading the effects of the level of dependence simple—communication did not change the direction of the level of dependence effect. This is the difference between the top row of moderating effects vs. the middle or bottom row in Figure 2 in Podsakoff et al. (1995, p. 432). The interaction of communication with all other variables was non-significant, which means that the nature of the other manipulation effects was not changed by allowing communication. For the simplicity of the following analysis I chose to group the two communication conditions into one, eliminating the between-subjects component of the factorial design. For the rest of the analysis the helping behaviours dependent variable is the sum of helping behaviours over all 20 rounds of the experiment. The resulting design is a 2 (low vs. high dependence) $\times$ 2 (asymmetric vs. symmetric) $\times$ 2 (individual vs. group rewards) completely crossed factorial.

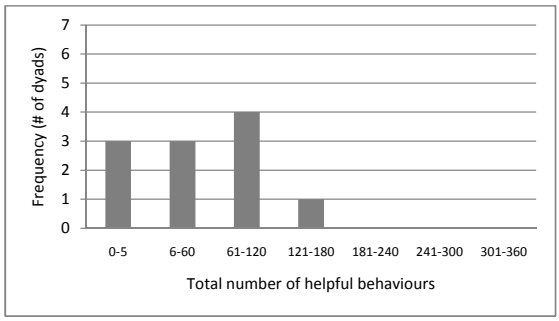
For the remaining analysis, three ANOVAs were chosen over a single MANOVA. A

	Individual rewards				Group rewards			
	Asymmetric		Symmetric		Asymmetric		Symmetric	
	Low dep.	High dep.	Low dep.	High dep.	Low dep.	High dep.	Low dep.	High dep.
Helpful Behaviours								
Rounds 1 to 10								
M	6.45	13.91	10.25	34.00	18.00	46.45	23.73	56.09
SD	9.65	25.47	11.14	30.07	17.50	34.27	24.58	37.64
Rounds 11 to 20								
M	30.55	45.18	22.75	111.75	50.67	103.55	48.45	121.82
SD	59.52	39.23	36.87	47.88	56.85	37.80	38.65	56.40
All Rounds								
M	37.00	59.09	33.00	145.75	68.67	150.00	72.18	177.91
SD	62.59	51.33	40.75	69.50	68.96	50.11	59.75	76.64
Intragroup Conflict								
M	2.15	2.42	1.88	1.91	1.74	2.27	1.68	1.83
SD	0.71	0.43	0.60	0.46	0.44	0.76	0.58	0.52
Task-related comm. (words)								
M	98.36	92.46	42.08	139.33	128.00	122.55	92.36	131.46
SD	98.55	69.59	63.98	136.50	142.84	78.12	107.73	89.09
No. groups/cell	11	11	12	12	12	11	11	11

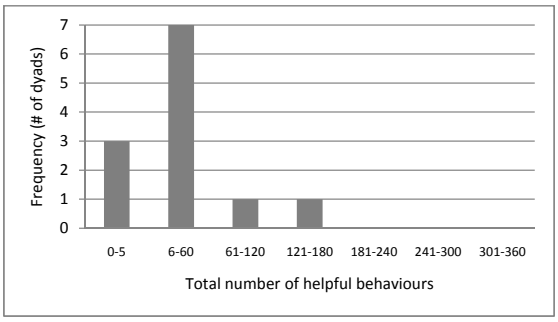
Table 5.4: Means and standard deviations for Helpful Behaviours, Task-related Communication (in words), and Intragroup Conflict across levels of dependence, mutuality, and reward manipulations



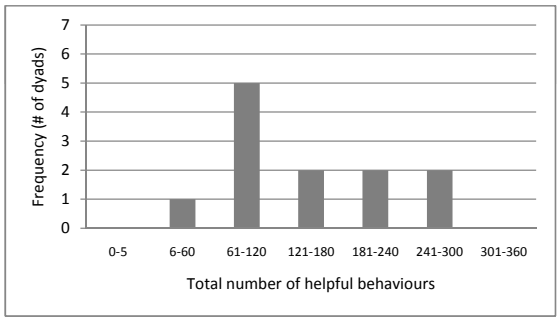
Low dependence, Asymmetric, Individual Reward



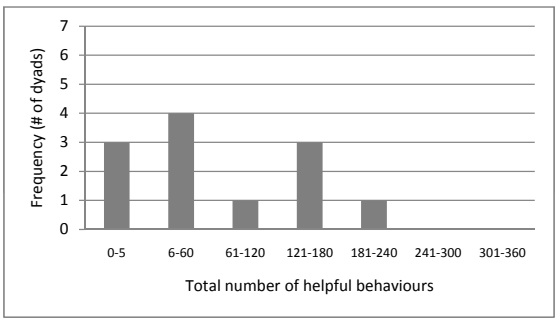
High dependence, Asymmetric, Individual Reward



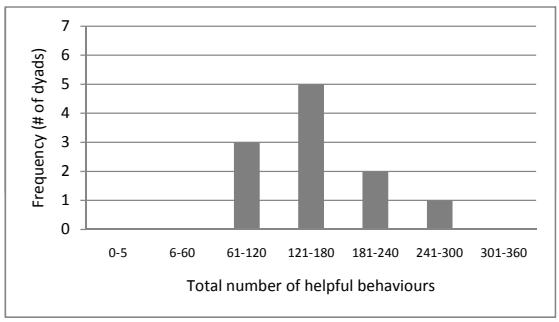
Low dependence, Symmetric, Individual Reward



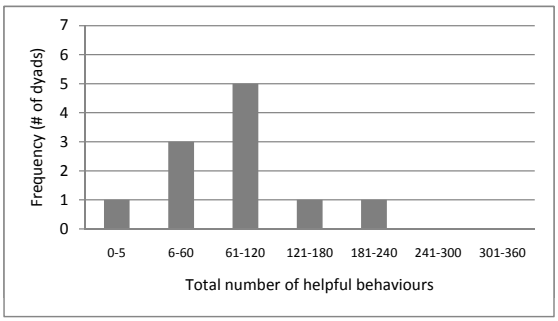
High dependence, Symmetric, Individual Reward



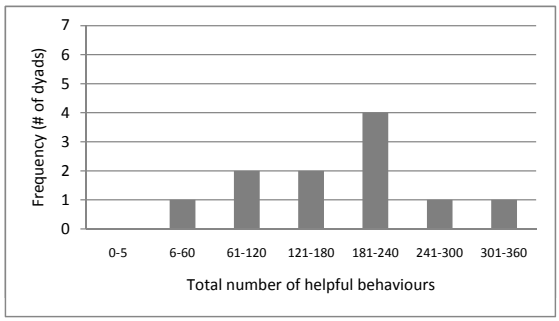
Low dependence, Asymmetric, Group Reward



High dependence, Asymmetric, Group Reward



Low dependence, Symmetric, Group Reward



High dependence, Symmetric, Group Reward

Figure 5.2: Distributions of helpful behaviours (all rounds), by condition

	1	2	3	4	5	6
1. Helpful Behaviors	—					
2. Intragroup conflict	-0.247*	—				
3. Task-related Communication	0.222*	-0.119	—			
4. Level of Dependency	0.515**	0.204	0.155	—		
5. Mutuality	0.178	-0.260*	-0.048	0.011	—	
6. Reward	0.297**	-0.172	0.126	-0.011	-0.033	—

Note. N=91 groups. Level of dependence was coded as 0 = low level, 1 = high level. Mutuality was coded as 0 = asymmetric, 1 = symmetric. Reward was coded as 0 = individual, 1 = group. Tests of significance are two-tailed.
* $p < .05$. ** $p < .01$

Table 5.5: Correlations among independent and dependent variables.

Source of variation	df	MS	F	η^2
Comm	1	75341.08	71.69***	0.46
Comm×Dependency	1	13486.92	12.83***	0.13
Comm×Mutuality	1	898.57	0.86	0.01
Comm×Reward	1	849.52	0.81	0.01
Comm×Dependency×Mutuality	1	3954.12	3.76	0.04
Comm×Dependency×Reward	1	34.85	0.03	0.00
Comm×Mutuality×Reward	1	829.55	0.79	0.01
Comm×Dependency×Mutuality×Reward	1	1221.80	1.16	0.01

Note. $N = 91$ groups. *** $p < .001$

Table 5.6: Four-way mixed ANOVA for helpful behaviours. Within-subject manipulation of Communication and between-subjects manipulation of level of Dependency, Reward, and Mutuality.

MANOVA answers the question of whether or not a combination of the three dependent variables varies as a function of the manipulations (Tabachnick and Fidell 2007b, p. 243). Huberty and Morris (1989) explain the distinction between univariate and multivariate questions: for univariate questions: "there would be no interest in seeking any linear composite of the outcome variables; an underlying construct is of no concern" (p. 303). This study presents no argument that helpful behaviours, conflict, and communications represent a single underlying conceptual variable. When testing multiple ANOVAs inflated Type I error becomes a concern. But Type I error is problematic only "if the set of conclusions must be evaluated as a whole" (Shaffer 1995, p. 562). Because the dependent variables are not measuring a single underlying conceptual variable, and because there are no hypotheses regarding the joint effects of the dependent variables, inflated Type I error between the three ANOVAs is not a concern and experiment-wise alpha adjustments will not be needed.

The results of three three-way analysis of variances (ANOVA) for helpful behaviours, intragroup conflict, task-related communication by level of dependence, mutuality of dependence, and reward interdependence are presented in Table 5.7.

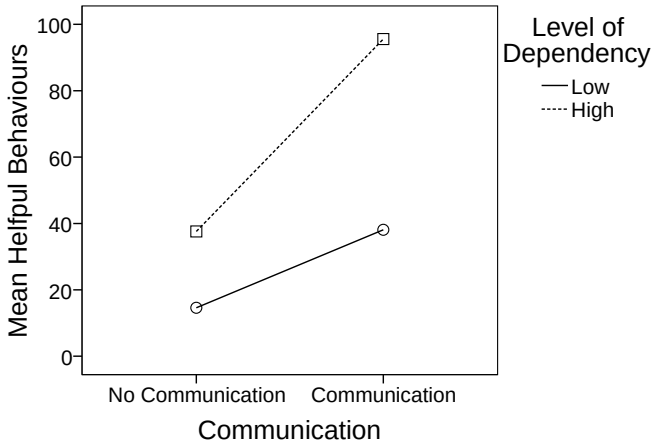


Figure 5.3: Interaction of communication by level of dependence on helpful behaviours.

Hypotheses 1a, 2a, and 3a dealt with the effects of dependency, mutuality, and their interaction effect on helpful behaviours. Hypotheses 1a and 2a predict main effects for level of dependency and mutuality, but as there was an interaction effect between level of dependence and mutuality, caution should be used in interpreting their main effects until the interaction effect is understood.

Hypothesis 3a predicted mutuality of dependence would strengthen the effect of level of dependence. There was a significant interaction effect between level dependence and the mutuality manipulations, $F(1, 83) = 5.05, p < .05, \eta^2 = .057$, illustrated in Figure 5.4. The effect of level of dependence was stronger in symmetric situations than in asymmetric situations. Specifically, in the low level of dependence condition, there is no significant difference ($F(1, 83) = .01, p > .05$) between the number of helpful behaviours in the asymmetric condition ($M = 53.52, SD = 66.49$) and the symmetric condition ($M = 51.74, SD = 53.42$). The number of helpful behaviours was significantly higher ($F(1, 83) = 10.31, p < .025$) in the symmetric condition ($M = 161.13, SD = 73.17$) than in the asymmetric condition ($M = 104.55, SD = 67.93$).[1] Therefore, Hypothesis 3a was supported; the effect of level of dependence was stronger in symmetric than in asymmetric task-relationships.

Hypothesis 1a predicted that a high level of dependence would afford and create forces towards more helpful behaviours than a low level of dependence. The main effect of level of dependence on helpful behaviours was significant ($F(1, 83) = 39.54, p < .001, \eta^2 = .323$).

[1] To control for the Type I family-wise error rate, the Bonferroni correction was used for the simple effects analysis of interactions. Two post-hoc tests were performed with an adjusted $\alpha = .05/2 = .025$ (Tabachnick and Fidell 2007a, p. 130).

Source of variation	*df*	MS	F	η^2
Helpful Behaviours				
Dependency	1	147074.38	39.54***	0.32
Mutuality	1	18472.91	4.97*	0.06
Reward	1	53372.96	14.35***	0.15
Dependency×Mutuality	1	18788.28	5.05*	0.06
Dependency×Reward	1	3870.43	1.04	0.01
Mutuality×Reward	1	3725.82	1.00	0.01
Dependency×Mutuality×Reward	1	6232.49	1.68	0.02
Intragroup Conflict				
Dependency	1	1.39	4.25*	0.05
Mutuality	1	2.37	7.27**	0.08
Reward	1	1.01	3.10	0.04
Dependency×Mutuality	1	0.56	1.73	0.02
Dependency×Reward	1	0.2	0.61	0.01
Mutuality×Reward	1	0.12	0.37	0.00
Dependency×Mutuality×Reward	1	0.03	0.10	0.00
Task-related Communication				
Dependency	1	22169.36	2.10	0.02
Mutuality	1	1852.67	0.18	0.00
Reward	1	14804.28	1.40	0.02
Dependency×Mutuality	1	30965.54	2.93	0.03
Dependency×Reward	1	4726.19	0.45	0.01
Mutuality×Reward	1	426.06	0.04	0.00
Dependency×Mutuality×Reward	1	4876.28	0.46	0.01

Note. $N = 91 groups$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5.7: Three-way Analysis of Variance for Helpful Behaviours, Intragroup Conflict, and Task-related Communication.

The effect was in the same direction when for both asymmetric and symmetric conditions, which makes interpretation simple. The average number of helping behaviours is lower in the low level of dependence condition ($M = 52.63, SD = 59.64$) and higher in the high level of dependence condition ($M = 133.47, SD = 75.48$). Thus, Hypothesis 1a was supported.

Hypothesis 2a predicted the same relationship between mutuality and helpful behaviours. But the effect of mutuality was trickier. Although there is a significant main effect for mutuality on helpful behaviour ($F(1, 83) = 4.97, p < .05, \eta^2 = .056$), and the average number of helpful behaviours increases from asymmetric ($M = 78.47, SD = 71.26$) to symmetric dependence ($M = 106.43, SD = 84.09$), mutuality does not appear to *independently* affect helpful behaviours. When in a low level of dependence the number of helpful behaviours are essentially the same in the asymmetric and symmetric conditions. The results indicate that symmetry of dependence can only be said to increase helpful behaviours when it is coupled with a high level of dependence. Thus, Hypothesis 2a was not supported. The consequences of this finding are discussed in Section 6.1.3.

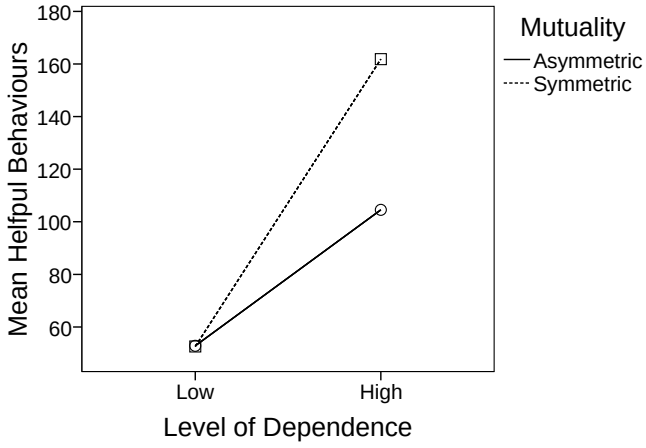


Figure 5.4: Interaction of level of dependence by mutuality on helpful behaviours.

Hypothesis 4a predicted that group rewards would lead to more helping behaviours than individual rewards. There was a significant main effect of the reward manipulation on the amount of helpful behaviours, $F(1, 83) = 14.35, p < .001, \eta^2 = .147$. Overall, the average number of helpful behaviours in the individual reward condition was $M = 69.61, SD = 72.34$, and in the group reward condition was $M = 116.11, SD = 79.02$. There were no significant interactions between reward and level of dependency ($F(1, 83) = 1.04, p > .05$) or mutuality ($F(1, 83) = 1.00, p > .05$), indicating that group rewards increase the amount of helping behaviours to the same degree in both low and high levels of dependence (Figure 5.5) and to the same degree in both asymmetric and symmetric dependence (Figure 5.6). Thus, Hypothesis 4a is supported.

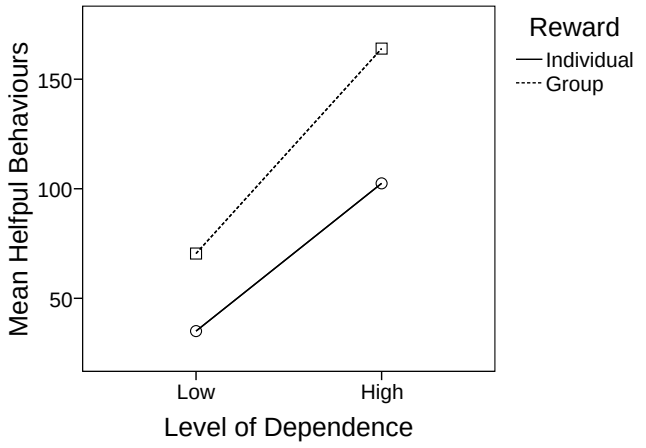


Figure 5.5: Interaction of level of dependence by reward interdependence on helpful behaviours.

Hypotheses 1b, 2b, and 4b dealt with the effects of the manipulations on the level of intragroup conflict. Hypothesis 1b predicted that a high level of dependence would lead to

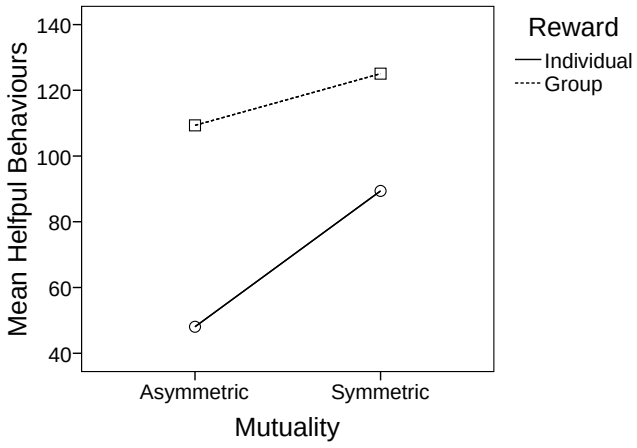


Figure 5.6: Interaction of mutuality by reward interdependence on helpful behaviours.

more intragroup conflict than a low level of dependence. There was a significant main effect of level of dependence on conflict, $F(1, 83) = 4.25, p < .05, \eta^2 = .049$, and the effect was in the direction predicted. Overall, the average conflict in the low level of dependence ($M = 1.86, SD = .59$) was lower than in the high level of dependence ($M = 2.10, SD = .59$). Thus, Hypothesis 1b was supported.

Hypothesis 2b predicted that symmetric situations would lead to less intragroup conflict than asymmetric situations. There was a significant main effect of mutuality on intragroup conflict, $F(1, 83) = 7.27, p < .01, \eta^2 = .08$. Overall, the average conflict in the asymmetric condition ($M = 2.14, SD = .64$) was higher than in the symmetric condition ($M = 1.83, SD = .53$). Thus, Hypothesis 2b was supported.

Hypothesis 4b predicted that group rewards would lead to less conflict than individual rewards. The effect for the reward manipulation was not significant at the $\alpha = .05$ level, but was marginally significant at the $\alpha = .10$ level ($F(1, 83) = 3.1, p < .10, \eta^2 = .036$). Conflict in the individual reward condition ($M = 2.08, SD = .58$) was slightly higher than in the group reward condition ($M = 1.88, SD = .61$). Thus, Hypothesis 4b received partial support.

Hypotheses 1c, 2c, and 4c concerned the effects of the manipulations on the number of task-related messages sent between the partners. It was hypothesized that a high level of dependence and group rewards would increase the amount of task-related communication between partners, and that symmetric situations would result in a lower number of task-related communications. None of the manipulations had significant effects on the number of task-related words communicated. Thus, Hypotheses 1c, 2c, and 4c did not receive support.

Chapter 6

Discussion

The results of the experiment support some aspects of the theory. This chapter will help explain which parts were supported, which weren't, and possible reasons why. The experiment findings also support and deepen the findings from the case study. Possible ways to improve the experiment and theory are considered.

6.1 Experiment discussion

The findings for the experiment are summarized in the familiar 2x2 presented in Table 6.1. To simplify the discussion I will discuss each dependent variable in turn.

		Mutuality of dependence	
		Asymmetric	Symmetric
Level of Dependence	Low	(A) low helping beh. $\longrightarrow$ high intragroup conflict	(B) low helping beh. lower intragroup conflict
		$\downarrow$	$\downarrow$
	High	(C) higher helping beh. $\longrightarrow$ higher intragroup conflict	(D) much higher helping beh. higher intragroup conflict

Table 6.1: Results: The effects of a change in level of dependence and mutuality of dependence

6.1.1 Task-related communication

The most straightforward findings are those dealing with the number of task-related words communicated between members of the dyads. Hypotheses 1c and 4c were not supported; the number of task-related words does not systematically vary due to any of the experimental manipulations. Re-running the analysis using task-related messages (instead of words)

did not change the result. This was somewhat surprising because it was assumed that if the helpee's expectations increased in strength there would be an corresponding increase in the need to understand what the helpee wanted, and this would lead to more communications. Conversely, if the helpee's expectations were relatively weak, there would be less need to understand the helpee's situation, and less communication. Hypothesis 2c argued that symmetric situations would tend to reduce the need for communication, but this result also was not found.

A possible explanation is that the task situation was relatively simple and an increased need to understand the other's situation did not *require* any extra task-related communication. A secondary explanation is that the communications were different, but not in number of words or number of messages. Perhaps the communication was different in the content of the messages. Perhaps situations of high dependence encouraged messages that were more urgent or intense than did situations of low dependence, or symmetric situations encouraged less urgent or intense messages than did asymmetric situations. A qualitative data analysis would be needed to test these revised explanations, or perhaps a mechanism could be added to the experiment program with which a participant could register intensity of their message.

6.1.2 Intragroup conflict

Intragroup conflict was found to be affected by level of dependence and mutuality of dependence. Significantly less conflict was found in the low level of dependence condition, and more conflict was found in the high level of dependence condition. This finding confirms Hypothesis 1b. Significantly more conflict was found in the asymmetric condition, and less conflict was found in the symmetric condition. This confirms Hypothesis 2b. These findings support the general theoretical argument proposed in the affordances and balance theory approach. However the cognitive mechanisms proposed to be operating were not measured, and thus the specifics of the theory cannot be supported with the current data. Simply, the reason for the intragroup conflict was not measured. However, as intragroup conflict was significantly affected by both level and mutuality of dependence, a possible causal mechanism can be proposed.

It is likely that the argument for situational affordances explains the difference in intragroup conflict: higher levels of dependence afford not only more helping behaviours between the help-giver and the help-receiver, but also *all* type of behaviours. In high levels of dependence the help-giver is afforded more opportunity to affect the help-receiver *in general*. Some of the effect is in the form of helpful behaviours, when A hypothetically reduces their cognitive tension by helping B. But some of the effect is less than helpful, when A hypothetically reduces their cognitive tension by breaking their unit relation with B, and is not helpful.

This results in B not having their expectations met, causing negative affect towards A which is captured by the intragroup conflict measure.

In situations of asymmetric dependence, B may perceive A's ability to affect their task as an intrusion and hypothetically experiences a mix of "anxiety, insecurity, and mistrust" (Drigotas et al. 1999; Kelley et al. 2003, p. 257). Asymmetric situations by definition lead to a greater power imbalance (Emerson 1962). Mutuality, on the other hand, evens out the power and control, thereby reducing the negative effects of asymmetric imbalance, resulting in a "more placid and positive emotional experience (less guilt, anxiety)... and greater stability and congeniality" (Rusbult and Van Lange 2003, p. 355). A is hypothetically less inclined to reduce their cognitive tension by breaking the unit relation, and has a better understanding of B's expectation (and vise versa). This results in less negative affect from A to B and B to A, which is captured by the intragroup conflict measure.

6.1.3 Helpful behaviours

The theory proposed that task interdependence affects helpful behaviours in a two step process. First, both level of dependence and mutuality of dependence afford helpful behaviours. Second, once afforded, both level and mutuality of dependence motivate the helper to perform helpful behaviours. But the findings indicate that this is not entirely accurate.

Level of dependence was found to independently affect helpful behaviours; the low dependence situation decreased the probability of helpful behaviours and the high dependence situation increased the probability of helpful behaviours. The results confirm Hypothesis 1a. The effect of mutuality was more complicated. Instead of independently affecting helpful behaviours, mutuality appears to only affect helpful behaviours in conjunction with a high level of dependence. In situations of low dependence, there is no difference in the number of helpful behaviours between asymmetric and symmetric conditions. On the other hand, in situations of high dependence, the asymmetric structure decreased the probability of helpful behaviours and the symmetric structure increased the probability of helpful behaviours. This confirms Hypothesis 3a, but fails to confirm Hypothesis 2a.

This finding clarifies our understanding of the role of level and mutuality of dependence. Level of dependence appears to both afford and motivate helpful behaviours, while mutuality appears to only motivate helpful behaviours. The explanation of why this is so is speculative, as the strength of the unit and sentiment relations in A's cognitive balance structure were not measured. Nevertheless, the outcome of the theory is supported by the experimental data. In terms of the theory (see Sections 4.1 and 4.2), symmetric situations hypothetically strengthen the unit relation between helper and helpee, pUo, and strengthen the mutual understanding

of the expectations and the social norms supporting that expectation, oLx. But mutuality does not afford helping behaviour by itself. Only in the presence of the affordances provided by a high level of dependence does the increased strength of the pUo and oLx relations provided by symmetric situations translate into an increased probability for helping behaviours. As mentioned, the preceding explanation is speculative and leaves room for future research to more carefully measure the underlying constructs.

6.2 Understanding the case study

The Application and Platform groups occupy cell (C) in Table 6.1—Application is asymmetrically dependent on Platform, and the level of dependence is quite high. It would appear at first that the findings from the experiment both support and contradict the case study's findings; the case study reports a high amount of intragroup conflict, but does not report a high number of helping behaviours.

The low number of helpful behaviours observed in the case study can be explained in four ways. One, the hypothesis that there would be more helpful behaviours is based on a *change* from low to high levels of dependence. The case study indicated that the level of dependence between Application and Platform had almost certainly increased over time. But, because the case study was conducted at one point in time, we do not know how the amount of helpfulness had changed. It could be that there actually were more helpful behaviours between Application and Platform as the level of dependence increased. We cannot know for sure due to time constraints and without a longitudinal methodology (see Section 2.4.1). A second explanation could be that there are more of both helpful *and* unhelpful behaviours in this high dependence situation, as hypothesized in Section 4.1. A third explanation could be that unhelpful behaviours had outweighed helpful behaviours due to bias from the interview questions, or unhelpful behaviours may have been easier to recall and may have made more of an impact on the interviewee (see Section 2.6.1). The interview methodology was designed to control bias and recall effects, but they are difficult to eliminate completely (see Section 2.4).

A forth explanation, and perhaps most plausible, is that the situational forces surrounding Platform encouraged them to resolve the tension they felt from Application's expectations by breaking the unit relation. Due to the way in which the groups were managed at the time of the study, Platform's immediate and long-term rewards were not based on how well they handled Application's requests. The Company's institutionalized practices, and software engineering practices in general, encouraged the Platform group to prioritize their own work and group goals far ahead of those of the groups that depended on them. Together, the situational forces may have resulted in a higher probability of non-helpful behaviours towards

Application, which were then cognitively justified by Platform. Some justifications *were* observed in the interview data: Platform stated that the relationship with Application was just fine, that there were no serious problems, that Platform was simply too busy and overloaded to do everything that Application wanted, that there were other groups that Platform needed to interact with, and that contentious features should just be handed over to the Application group. Platform's perception of their relationship with Application (Section 2.6.1), and particularly the behaviours that they expected from the Application group (Section 2.6.3), indicate that Platform didn't view the relationship to be as crucial as Application did, and that Application's expectations were either unreasonable or that Platform had met their obligation already. According to Heider (1958), these justifications are ways in which a unit relationship can be turned negative in order to balance the Platform's unit-sentiment triad and relieve cognitive tension.

Overall, the case study findings are strengthened by the experiment findings. From the case study findings alone, it was unclear whether the behaviours between Application and Platform were idiosyncratic to that particular relationship or those particular people and their personalities. The case study generated the hypothesis that perhaps some of the dysfunctional interactions could be explained by the way in which the teams were designed to interact. According to generally accepted software design principles, it would be ideal if Application depended entirely on Platform and Platform did not have any task-level dependency on Application. Asymmetric task-relationships limit circular dependencies and simplify the development of large-scale software systems (see Section 2.1). The case study could only suggest the hypothesis that the structure of the task-relationship influenced the behaviour observed.

The theory and experiment attempted to answer the questions raised by the case study. The experiment demonstrated that the way in which the groups were designed to interact may have itself influenced how the two teams behaved towards one another. The high level of asymmetric dependence may have contributed to greater intragroup conflict. And while greater level of dependence may have encouraged stronger expectations and forces towards helping, the lack of symmetry in their relationship may have limited the extent to which those expectations were translated into helpful behaviours.

6.3 Contributions to the literature

I believe that the theory and experiment make a number of contributions to the literature, primarily in clarifying the explanation for a help giver's prosocial behaviour to their dependents, and introducing an endogenous explanation for unhelpful behaviour. First, with regards to

prosocial motivation, the balance theory approach helps explain how the forces arise in the help giver as a result of their felt responsibility for their dependent (Kiggundu 1981, 1983; Pearce and Gregersen 1991). This removes the need for power to explain the forces towards action (Kahn et al. 1964), and the need for the help giver to like their dependent (Grant 2007). Balance theory also helps integrate the social norm explanation for behaviour. Previously, social norms were used as secondary supporting evidence for why prosocial behaviours would occur in organizations (e.g., Smith et al. 1983; McNeely and Meglino 1994; Settoon and Mossholder 2002; Bachrach et al. 2006a). In the balance theory approach taken here, norms are integral and support the dependent's expectations, which increase the forces acting on the helper—not towards helping behaviour directly, but away from the tension and discomfort that arises from breaking the norm (Flynn and Lake 2008). Norms are activated in the context of the relationship and contribute to the balance (or imbalance) of the situation.

Second, this approach helps explain why helpful behaviours are performed, but also why unhelpful behaviours are performed. The literature on prosocial organizational behaviours is, understandably, concerned with the antecedents and consequences of helpful behaviours. Unhelpful behaviours are rarely if ever explained using the same model. The balance theory approach views helpful behaviours as one of the possible actions available to a help-giver in order to relieve the cognitive tension produced by the social expectations of their coworker. Unhelpful behaviours are another action that would relieve cognitive tension. While this may seem counterintuitive, from this theoretical view unhelpful behaviours are the result of the help-giver breaking the unit-relation with their coworker, which balances the help-giver's cognitive triad. Unhelpful behaviours are then viewed as a rational response to a situation where the help-giver is expected to help.

An affordances and balance theory approach also helps to answer a question that is at the heart of much research into human behaviour. Under completely asymmetric dependence, where B depends on A, and A does not depend on B at all, why would A help B? Even further, why would *increasing* B's dependence on A cause A to help B more? Social exchange explanations of behaviour state that since A has nothing to gain from B, increasing the dependence would lead to a reduction in helping behaviour (Bowler and Brass 2006). Interdependence theory and power and dependence theory would argue the same: the powerful A, with nothing to gain, would have no reason to help the powerless B (de Jong et al. 2007). Underlying these organizational theories of human behaviour is the behavioural economics rational actor model (Gintis 2009), and the assumption that humans act in their own self interest (Henrich et al. 2005). But behavioural economics experiments, teasing apart every possible social influence acting on the participants of their experiments, have demonstrated that humans do act prosocially (Camerer 2003a; Colman 2003). Others have argued that it is not prosociality, but instead the influence of the other's expectations (Dana et al. 2006).

Behaviour that appears to be prosocial, and can only be explained using the word prosocial or other labels like altruism, are instead acts of rational humans. They are rational humans trying to satisfy their own needs, with one more condition: that their needs also include the expectations of others. But the question remains, *why* and *how* are expectations transformed into forces acting on the helper?

An affordance and balance theory approach does not solve this thorny issue conclusively, but it does offer a little more explanation as to what is happening. Why would A help B? And when B's dependence is increased, why would A help B even more? It is possibly because a situation of higher dependence is a situation that affords more helping behaviour, and it is a situation that causes B to increase their expectations for help. Those expectations create a force acting on A to increase their help to B. That force, and the conditions under which it acts to produce helping behaviour, is explained by balance theory. I believe this helps sort out the contradictory hypotheses and the inconclusive findings about the effect of asymmetric dependence on helping behaviour (Bowler and Brass 2006; de Jong et al. 2007).

6.4 Limitations of the experiment and boundary conditions

The card game experiment attempted to mix the social psychological and behavioural economics styles of experimentation. The game was designed to create a task-relationship and an amount of "groupness," while satisfying the constraints listed in Section 5.1.3. It was also designed to have some of the methodological rigour of behavioural economics experiments: participants were not deceived, were told explicitly all reward conditions, were given the costs and benefits of theirs and their partner's actions, and control questions attempted to ensure that participants understood the rules and conditions before they were allowed to participate (see Gintis 2009, pp. 49–52, and Camerer 2003a, pp. 34–42 for a review).

But maybe the experiment did not work as well as possible. The experiment was probably not "groupy" enough to qualify as a face-valid simulation of what real groups do in real work situations (e.g., Saavedra et al. 1993; Wageman and Baker 1997; Allen et al. 2003; Bachrach et al. 2006b). Participants were not face-to-face, their partner was never identified, and they were not completing a work-like task. Yet, it was also too complicated to qualify as a behavioural economics experiment. In experimental economics terms, the experiment was testing many "joint hypotheses" at once. Economics experiments are designed to reduce the number of competing explanations for findings, yet even very simple experiments can have joint hypothesis. For example, prisoner dilemma games are testing the joint hypotheses: 1) that players are self-interested (or that they have x amount of social preferences), and 2) that they are playing game-theoretically (Camerer 2003a, p. 48). This means if a player

does choose to play cooperatively with their partner, the experimenter can not definitively claim that this behaviour was a result of a social preference for cooperative behaviour, or if that person was playing a strategy and purely self-interestedly (that cooperating will earn them more money in the long run). The ultimatum game had the similar problem, as discussed in Section 3.3.8. The dictator game removed the element of strategy so that only the social preference hypothesis was tested.[1] Even in the simplest of economic experiments a researcher can be testing joint hypotheses, and as a result it is often impossible to make definitive conclusions from the results.

The card game experiment could be improved in a number of ways to reduce alternative explanations for the participant behaviour. First, the reward was probably quite weak. The reward was $20, and was awarded if the participant could get the lowest cost as compared to 11 or 12 other participants (a "tournament structure"). A participant could not tell how competitive they were based on their own costs, and a proportion of their costs were random based on the card distributions. In contrast, the behavioural economics studies are careful to tie rewards directly to a choice (e.g., Dana et al. 2006), or on a random subset of all choices made (e.g., Bottom et al. 2006), and the rewards are money which is easy to understand and always wanted. Camerer (2003a) put it this way:

> By inducing value using money payments, the experimenter need rely only on the assumptions that everybody likes having more money and nobody gets tired of having more of it. These are safe assumptions, and substantially safer than figuring out whether somebody is motivated by having their name posted if they did best (some people might be embarrassed by it), is likely to give up if they are far behind when payoffs have a tournament structure, and so forth. (If you know anybody who is tired of getting more money let me know; I'll take their leftovers!) (p. 39)

In this way the forces acting on the participants are more carefully controlled and are acting as intended. In the card game experiment it is difficult to tell how powerful the reward's force was (due to the reward's tournament structure). Drawing a card needed to be personally costly so that helpful behaviours were costly. The lack of powerful force could have effected the help-giver by making helping behaviours less costly, but it could have also affected the help-seeker by reducing the strength of their expectations. As a result, the experiment may have been biased towards producing helpful behaviours. In order to improve

[1] Although we now know that there was an even deeper joint hypothesis: that 1) the player was displaying a social preference for altruism, or 2) the player was avoiding the discomfort of appearing to violate the other player's social expectations.

this, the experiment would need to tie behaviour directly to monetary reward. Perhaps the reward payment could be based directly on their total hand cost. Or the experimenter could give the participants an endowment and observe how helpful they are if it means physically giving away money they already have, which would invoke loss aversion. It would be useful to see if strengthening these forces would eliminate the helping behaviour observed in the results.[2]

Second, the game lasted 20 rounds, which in retrospect may have been tiring for the participants. A small fraction of participants sent messages to their partners complaining they were tired of clicking, or messaged that they were getting bored. On the one hand, 20 rounds reduces the variance in the helpful behaviours dependent variable. Further, more rounds allowed the help-giver to experience the force of the help-seeker's expectations and adjust their behaviour to reduce their tension. On the other hand, and more importantly, exhaustion or boredom effects could have threatened internal validity. Perhaps the number of rounds could have been reduced, and coupled with the direct reward proposed above the situation would have more experimental realism (Aronson et al. 1990, p. 70).

In defence of the experiment, the situation appeared to have enough experimental realism and the manipulations had enough power to result in significant differences in the number of helpful behaviours and in intragroup conflict. But I believe the experiment could be improved greatly by strengthening the forces acting on the help-giver and help-receiver.

The limitations of the card game also have to do with properties of the theory which was tested. In the affordances and balance theory approach being proposed, a number of steps connect the situation to helping behaviour. One, A perceives themselves and B as a unit, pUo, which is perhaps increased by a sense of responsibility for their dependent's work, group cohesion, or a perceived impact on their dependent's work. Two, B's social expectations, oLx, increase as a result of increased reciprocal interaction, perspective taking, emphatic concern, and a number of social norms which may be activated in their relationship. Three, A perceives B's social expectation to have warrant and support. Four, A perceives tension in their relationship with B. This tension results from an imbalance in their unit-sentiment triad: their unit relation with B, pUo, B's social expectations, oLx, and A's level of helping behaviour, pLx. Five, A moves to resolve that tension in one of the ways specified in Section 4.2.2, some of which will be fulfilling B's expectations to behave helpfully. Step five is the theoretical consequences of the preceding steps, and we can test it with A's helpful

[2] I don't believe it would eliminate helping completely, but it would certainly reduce the absolute number helpful behaviours. The question then is whether or not the experimental manipulations would still show an effect on helping behaviour—which is what we are most interested in, not the absolute number of helpful behaviours. That is, would the probability of helping behaviours still increase when moving from a low level of dependence to a high level of dependence? The theory would hypothesize that it would, but this should be tested experimentally.

behaviours. Steps one, two, three, and four, on the other hand, are the joint hypotheses being tested in the card game experiment. Perhaps even other hypotheses are being tested, as in the case of the ultimatum game above; A could be acting strategically in helping B, instead of reducing tension felt by an imbalance of their unit-sentiment triad. Future work could carefully pick apart each of the steps in this process to test how each step responds (if at all) to task-structure manipulations, norm manipulations, social manipulations such as knowledge of and repeated games with the help-receiver, and so forth.

6.5 Practical implications

I am hesitant to make any recommendations based on the current work (and who would listen?). But the case study does highlight one important issue: Application, in its completely asymmetric relationship with Platform, felt that Platform didn't understand their point of view, and didn't realize the amount of impact they had. Symmetric dependence would almost certainly improve that, by making Platform equivalently dependent on Application's behaviour, and would presumably encourage perspective taking (Parker and Axtell 2001) and felt responsibility (Kiggundu 1981). This is obviously a very difficult structural change to make, and it is unclear whether or not it would be a net benefit; perhaps in software engineering the unintended consequences of an asymmetric relationship are acceptable, compared to the technical nightmare of having two teams symmetrically task related on a daily basis. Perhaps a more realistic intervention would be to encourage perspective taking or other methods to help Platform understand the effect they have on Application. The extent to which these are substitutable for true task-related mutuality is a question for further research.

Wageman and Baker (1997) and de Jong et al. (2007) made arguments that reward interdependence might be able to soften the negative impact of task dependence; if two teams are not structurally encouraged to be helpful towards one another, perhaps increasing the amount of group rewards for both teams is an easy way of inducing cooperation. The findings in this study clarified the contradictions between those studies and the findings of Allen et al. (2003). It appears that group rewards do have a positive effect on helpful behaviours. The boundary conditions on this effect are essentially unknown, though. Will this effect persist if the experiment were modified as suggested above? Although group rewards may encourage helpful behaviours in the laboratory, real work situations are different; if asymmetry presents significant task-related constraints and incentives to behave self-interestedly and in conflict, are group rewards a strong enough force to encourage helpful behaviours? Further, how fair or realistic would it be to Platform to have their rewards based on Application's performance, even if Application is heavily dependent on Application's work? Such

a solution could encounter organizational or even labour relations and legal issues.

6.6 Conclusion

Work teams are often a complicated mess of interconnected, uncertain, shifting dependencies that are only understood in a haphazard and socially constructed way after the fact (Staudenmayer 1997). But some interdependencies are relatively stable patterns of dependence, designed into the system by task requirements. Such is the case for software teams that are deliberately designed to be asymmetrically dependent in order to minimize code-level dependency loops. For those teams that are shifting and changing and only understood after the fact, it may be difficult for an observer to causally attribute behaviour to the task-dependence itself. But for those situations where patterns of interdependence are stable and clear, it is possible that the task-dependence may itself be a cause of conflict and unhelpful behaviours. It may also be a cause for cooperation and helpful behaviours. It is important to understand then, in those situations where interdependencies are clear and powerful, how the task-dependence is influencing individual behaviour.

The theory and experiment described in this dissertation attempted to explain and demonstrate how task-dependence caused a change in behaviour. Previous theory had trouble explaining why, ceteris paribus, a high level of dependence between A and B would lead to more helpful behaviours from A, when compared to a low level of dependence, especially in situations where A does not likewise depend on B. The affordance and balance theory approach explained that in a high level of dependence, and in a symmetrically dependent situation, B will have high expectations for help, and this causes a set of forces to act on A motivating them towards helpful behaviours. The experiment demonstrated that a high level of dependence is necessary for helpful behaviours to increase—without the ability and opportunity afforded by task-dependence, a high social expectation will have little effect on the amount of helping behaviour.

Appendix A

Official organization chart

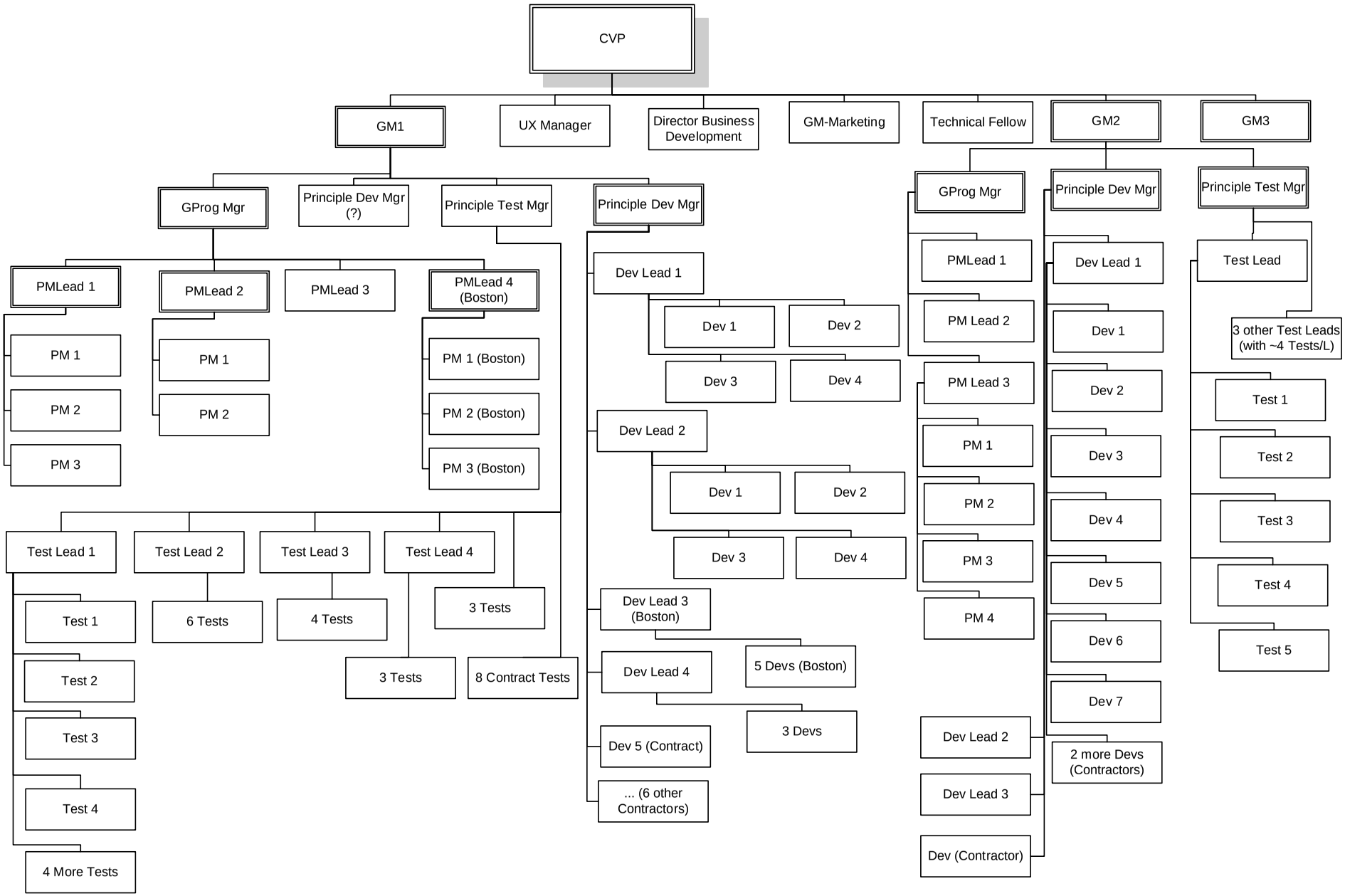


Figure A.1: Official organization chart

Appendix B

Script and screen captures of the training video

Every condition:

Thank you for participating in this experiment.

I will briefly describe the task you will be given, how your performance will be measured, and how you can compete to win $20 (Figure B.1).

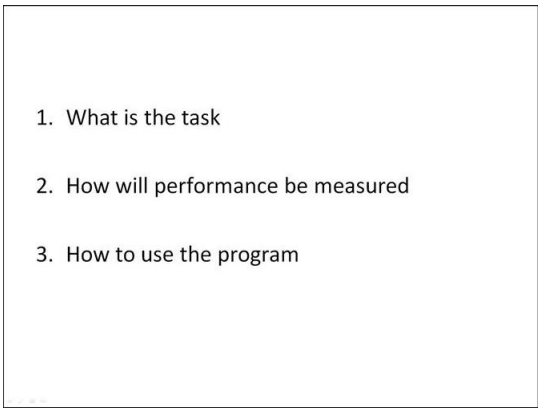


Figure B.1

You will be paired with another person in this room, but you will not know who it is. One of you will be "A," and the other will be "B." You and your partner will be playing this card game as a team. In this card game you have a "hand" which can hold two cards. The two cards in your hand sum up to the total value of your hand (Figure B.2).

You will draw new cards from a deck and choose which cards to keep in your hand. The deck is filled with Aces through to 10's, no face cards. Aces are worth 1, 2's are worth 2, and so forth (Figure B.3).

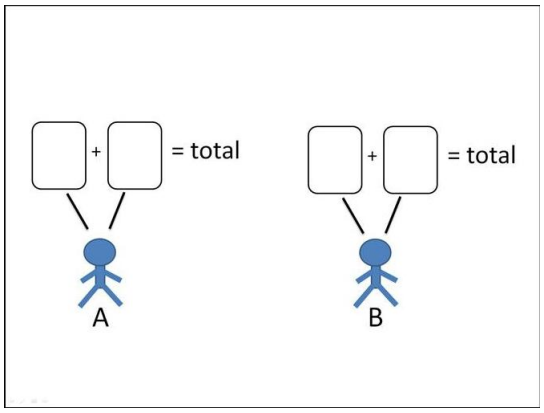


Figure B.2

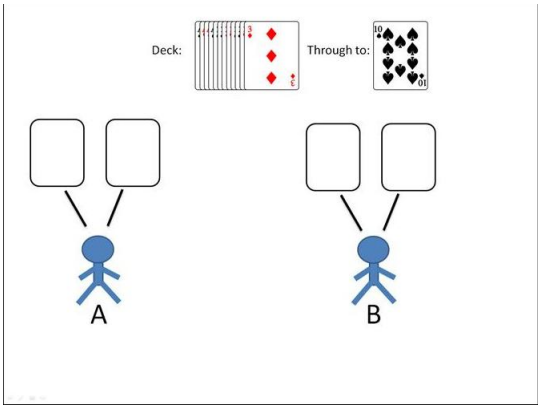


Figure B.3

For each round, A and B have a goal. The goal for each round is to hit (or go over) the target number with the two cards in your hand, in the least number of draws. A goes first. Once A hits (or goes over) their target, A can send those cards to B. B will use those cards to reach their own target (Figure B.4).

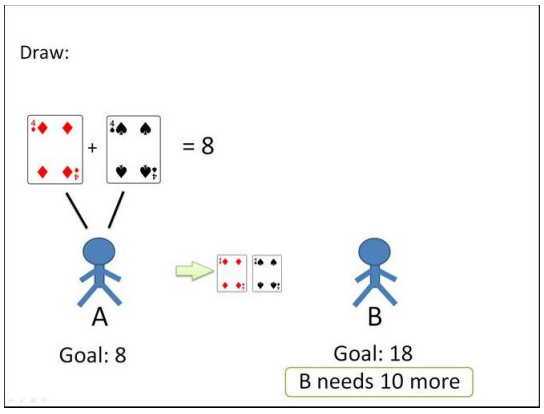


Figure B.4

B will take the cards sent by A, and then add their own cards in order to hit their target.

In this case, B takes the 8 sent by A, and now needs 10 more to reach their target. We can call this "dependence" – B depends on A in order to reach their goal. Once B reaches their goal, they can send their cards. If B reaches their goal and sends their cards, the team completes a successful round (Figure B.5).

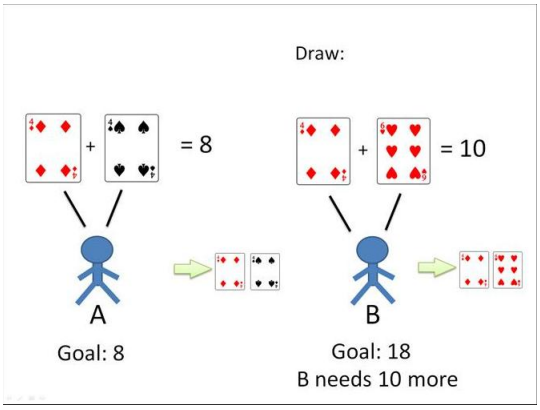


Figure B.5

However, cards have a cost, and you have a budget. Every card that A draws costs 1, and brings A closer to the budget limit. Here, A has reached the goal of 8 using 6 cards, which is well below their budget of 25. If a player cannot reach their goal within their budget, they will need to give up the round, and both team members will fail that round (Figure B.6).

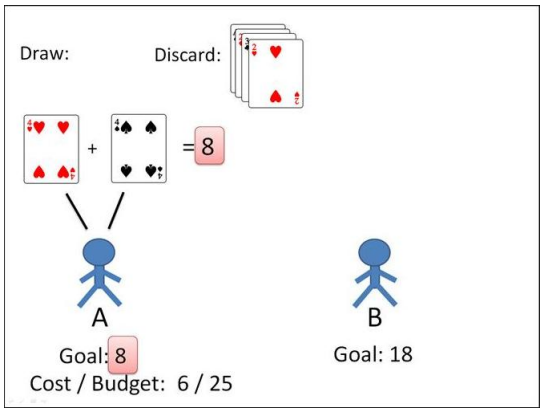


Figure B.6

You may be wondering, What cards are in the deck? The cards that you draw will change, based on how many cards you have already drawn that round. The first five cards that you draw will be Ace's, 2's, or 3's. That is the deck for the first five draws. The probability of getting each card is different. You have a 60% chance of getting an A, a 25% chance of getting a 2, and a 15% chance of getting a 3. It is harder to get higher cards.

The next five cards that you draw will be 2's, 3's, or 4's. This is the deck for your 6th to 10th cards. Just like before, it is easier to get lower cards, and harder to get higher cards.

For draw numbers 11 to 15, that is, for the 11th through 15th card that you draw, the cards will be 3s, 4s, and 5s. Draw numbers 16 to 20, 21 to 25, and 26 to 30 will give you

higher numbered cards. For example, if you draw your 26th card, you are guaranteed to get a 6, a 7, or an 8. Your handout sheet has a summary of the card distributions which you can reference during the game (Figure B.7).

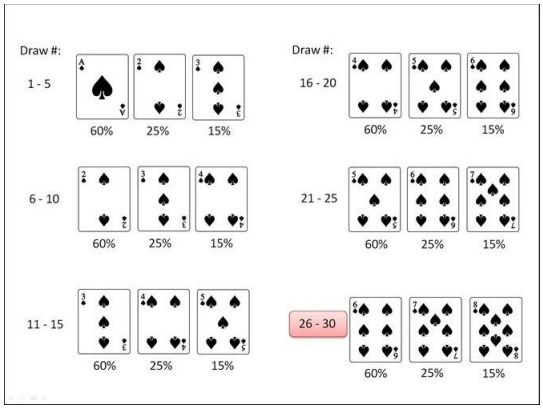


Figure B.7

Asymmetric Condition:

What happens after round 1?

In round 1, when A reaches their goal they send their cards to B. B uses those cards to try to reach their goal. B depends on A. B sends their cards, and the team has a success.

In round 2, the sequence simply repeats. A sends their cards to B, which means B depends on A. B sends their cards for a team success.

Round 3 is the same, and so on. For every round in the game, A sends their cards to B, and B uses those cards to try to reach their goal.

Symmetric Condition:

What happens after round 1?

In round 1, when A reaches their goal they send their cards to B. B uses those cards to try to reach their goal. B depends on A. B sends their cards, and the team has a success.

In round 2, the sequence is reversed. This time B starts first. B reaches their goal and sends their cards to A. A uses those cards to try to reach their goal. In other words, this time A depends on B. A sends their cards, and the team has a success.

In round 3, the sequence is reversed. A starts first, and sends their cards to B. B sends their cards for a team success.

In round 4, the sequence is reversed again. This time B starts, and A depends on B. In round 5, it is revered. The sequence alternates for every round - first B depends on A, then A depends on B (Figure B.8).

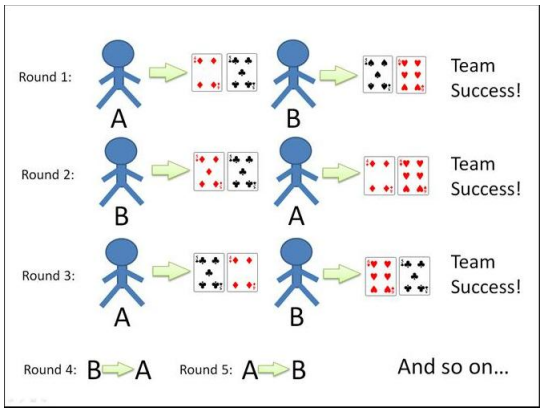


Figure B.8

Every condition:

That concludes the summary of your task. Now we will go through how your performance will be measured, and how you can win $20 (Figure B.9).

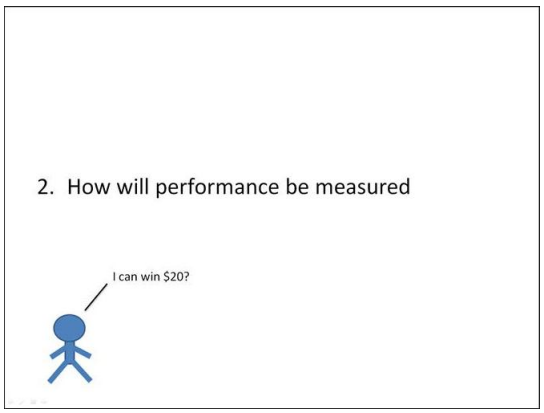


Figure B.9

Individual Reward Condition:

You will be measured by how many cards you draw. Cards are not free; each card you draw will cost 1. This is your only performance measure.

For example, even if your partner fails a round, and your team is unable to complete a successful round, will be measured only by the cost of the cards you drew. In other words, there is no punishment for your team failing a round.

For example, suppose it costs A 12 to get 2 cards, and A sends their cards to B. However, using those cards, B is unable to reach their goal. B's cost for that round will be their full budget for that round.

Suppose A gave up their round. Their cost is the budget for that round. B did not draw any cards that round, therefore their cost is 0, and their average cost will be unchanged. In

summary, it is only the number of cards you draw that will affect your average cost, and that will affect your ability to win the competition.

Group Reward Condition:

You will be measured by a combination of how many cards you draw and how many successful rounds your team can complete. Cards are not free; each card you draw will cost 1. Also, your team's success will affect your performance, because a failed round will cost 15. Both team mates are affected by the team's performance.

For example, suppose it costs A 12 to get two cards, and A sends their cards to B. However, using those cards, B is unable to reach their goal. B's cost for that round will be their full budget for that round. And because the team failed, both team members are charged an additional 15 (Figure B.10).

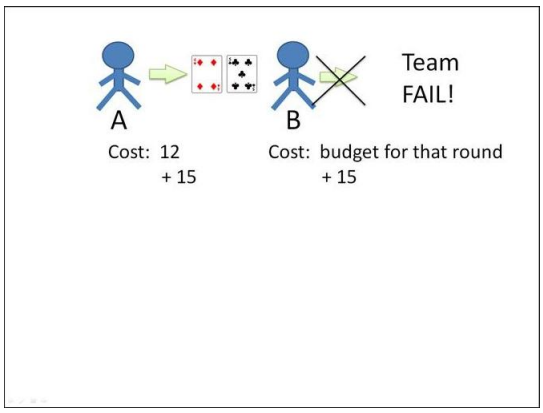


Figure B.10

Suppose A gave up their round. Their cost is their budget for that round. B did not draw any cards that round, therefore their cost is 0. And because the team failed, both team members are charged an additional 15. In this way, failing a round will affect your average cost for the entire game, and that will affect your ability to win the competition (Figure B.11).

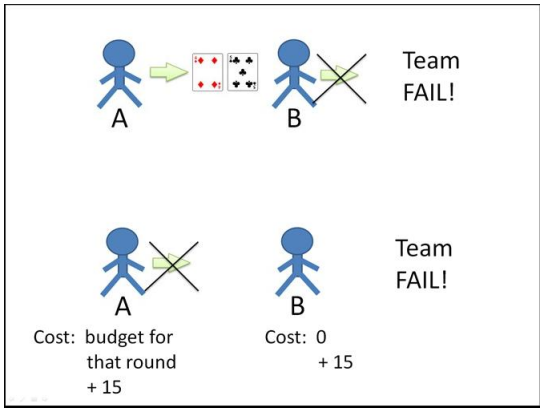


Figure B.11

Every condition:

After 10 rounds you will be able to communicate with your partner using an instant messenger system built into the experiment program.

Who am I in competition with?

Since A's and B's are in different situations, you won't be competing with your team mate. Instead, you will be competing with the other participants in the same situation as you. So all A's will compete, and all B's will compete.

For example, after the game ends we will rank all the A's. We will rank everyone based on their average cost for all rounds. The person in the number 1 spot will be the one with the lowest average cost. The person who drew the fewest cards will win the $20 prize (Figure B.12).

Figure B.12

We've now seen What the task is, and How your performance will be measured. Let's now look at:

How to use the Program

Let's start with A. The program is very simple, with most of the space taken up with information that you can use to judge how well you're doing in the game. To the right we have the instant message communication that you'll be able to use after the 10th round. On the bottom there is a status bar for messages from the server. The top right shows your current card, and the top centre shows your hand. A can Draw a new card, and then has the option of moving that card to their hand, discarding the current card, and giving up the round (we won't do that unless we can't reach the goal and we've run out of budget). I will move this card to the hand to show how it's done. Then we'll draw some more cards, and move them into the hand. You can see that the program gives us the total of the Hand, and whether or not we've reached the goal. Obviously we haven't reached our goal yet, so we'll draw some more cards. As we're drawing cards we can see "this round's cost" is increasing. If we hit our budget, and we haven't reached our goal, then we'll have to give up. Once we have a card that we'd like to swap, we can discard one of the cards in our hand, that frees up a space, and we can move the current card into our hand. We can draw some more cards until we have

another card we want to keep. Now we've reached our target and the "send cards" button is now active, showing that we can send our cards to our partner.

Here is an important aspect of the game. A is not forced to send the cards, even though they have reached their target. If they wish, they may continue to draw cards. A may wish to do this in order to get a higher hand total, which I'll try to do now. Notice that while I'm doing this, the cost for this round is increasing. So getting a higher hand total to send to B is costing A. Now that A has a higher total, as you can see we've exceeded the goal, we can send the cards to B (Figure B.13).

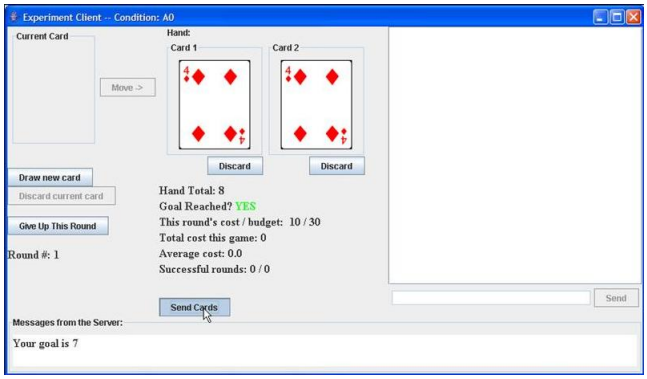


Figure B.13

Let's move to B now. B will receive the following message: you have been sent these cards. Your goal is <> so your target is now <> (Figure B.14).

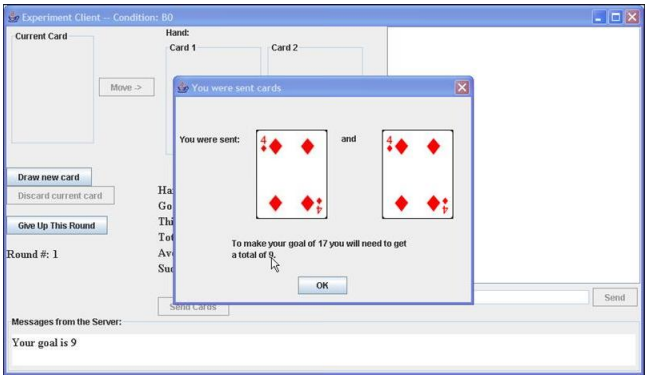


Figure B.14

B pressed OK, and we can see that they now have the same task. B must now try to reach their goal with the least number of cards, and within their budget. We've done this now with <> cost, the hand total meets our target, and we can send these cards. We have a successful round, and the next round can begin. That is how this game is played (Figure B.15).

After the fifth round of play you will be able to communicate with your partner. You can communicate anything you wish, as many times as you wish. We only ask that you not reveal your name or your identity to your partner.

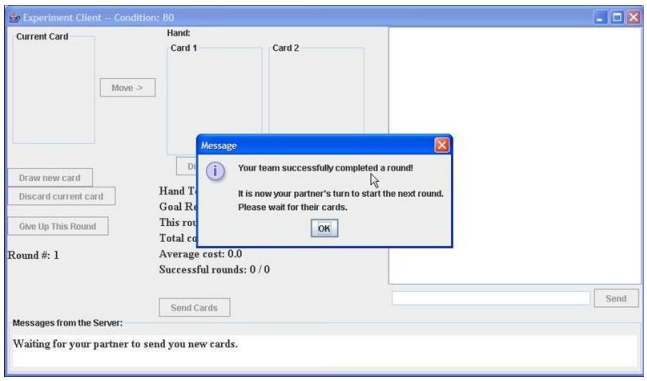


Figure B.15

Summary - Individual Reward:

In summary, please remember the following points.

- There are 20 rounds in the game, total.
- You will be able to communicate with your partner after 10 rounds.
- You are not in competition with your partner. This means that you both could win the $20 prize, if you both do well enough.
- For performance measurement, only your cost matters. Your average cost will not be affected if your team fails a round.
- And finally, the lowest average cost will win the $20 prize.

Good luck.

Summary - Group Reward:

In summary, please remember the following points (Figure B.16).

- There are 20 rounds in the game, total.
- You will be able to communicate with your partner after 10 rounds.
- You are not in competition with your partner. This means that you both could win the $20 prize, if you both do well enough.
- For performance measurement, teamwork matters. A penalty of 15 will be added to your cost for every failed round for your team.
- And finally, the lowest average cost will win the $20 prize.

Good luck.

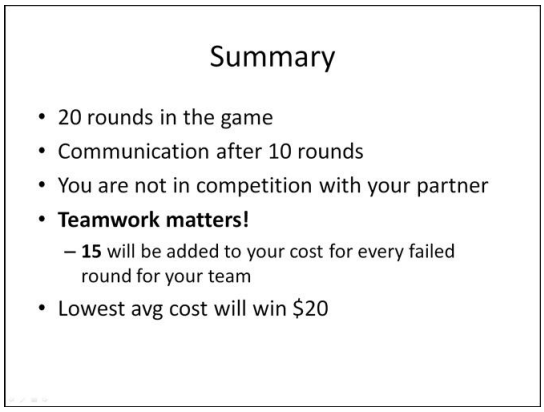

Summary
• 20 rounds in the game
• Communication after 10 rounds
• You are not in competition with your partner
• Teamwork matters!
– 15 will be added to your cost for every failed round for your team
• Lowest avg cost will win $20

Figure B.16

Appendix C

Screen capture of control questions

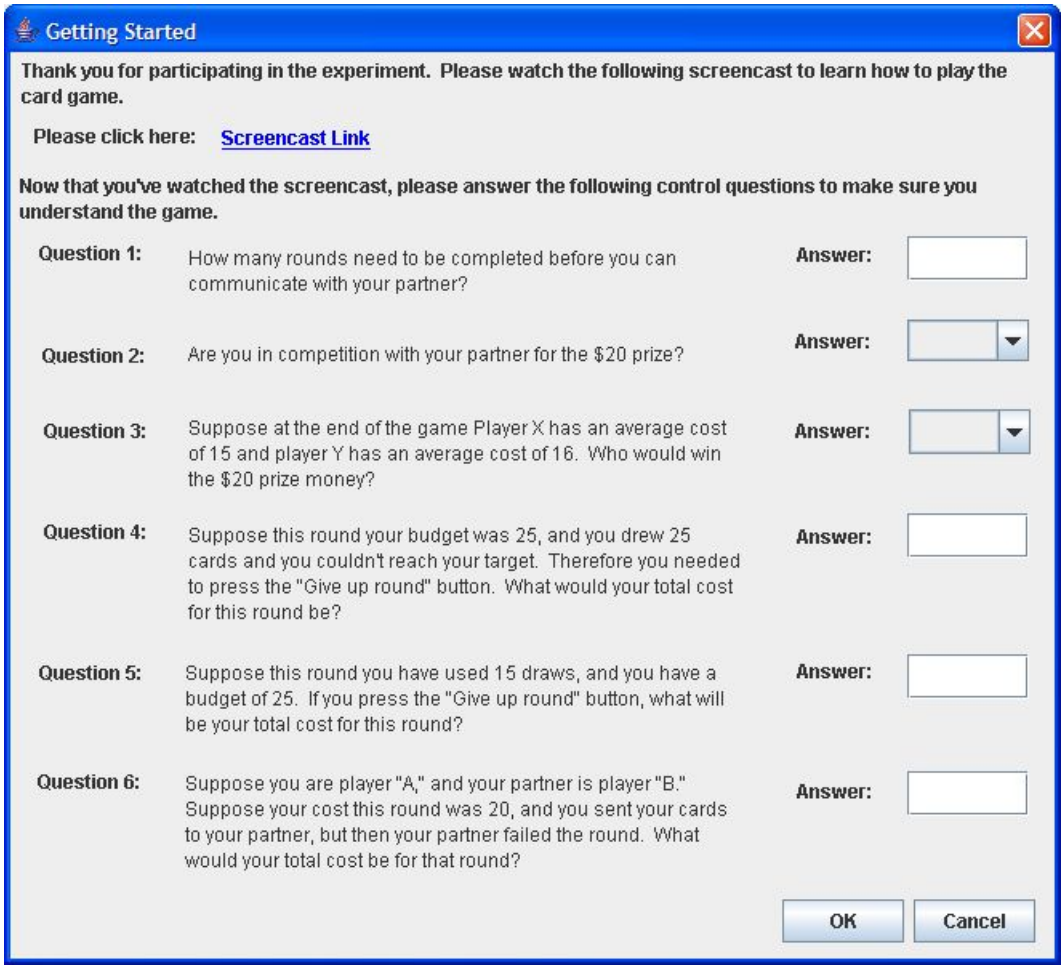


Figure C.1: Screen capture of control questions.

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