Me and you and everyone we know : social influences and processes in technology adoption

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Social Influences and Processes in Technology Adoption

Jeroen J.L. Schepers

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In many respects, carrying out PhD research is like riding a bicycle. When you start to learn the art of riding, you would ideally start on a flat, straight road without any obstacles. The learning curve seems very steep, but a high level of motivation and some parental support allow for great steps of progress to be made. In no-time you will be touring around on your bicycle and enjoying the scenery. While you are still pretty inexperienced though, there are times when you might fall unexpectedly. This is very likely to hurt, but your stamina keeps you going! When you have enough skill to travel longer distances, you soon discover that the world is not entirely flat. Cycling through the landscape, a mountain appears on the horizon. Confidently you start to climb it, but almost halfway the climb your heartbeat goes up, you feel the energy slowly fading away, and you start wondering why you started cycling anyway! Why not travel by car in future? Exhausted you make a short stop at the terrace of a café nearby. You are surprised to see cyclists looking just as desperate as you are! The waiter comes over, stops to look at you, and says he has got just what you need: a healthy meal. After you have finished eating, and after sharing numerous stories and experiences with your fellow cyclists, you get back on your bicycle again. Fully energized and motivated you climb to the top of the mountain and enjoy the marvelous view. While you are standing there, you realize that the people you met during your stopover were vital in your strive to reach the mountain top. Without the support of these people you would probably not have completed your journey.

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Chapter 1
Introduction

This first chapter introduces the topic of this dissertation and its relevance. First, it provides a short overview of the technology adoption literature. After introducing the central research problem, it discusses the objectives of the three studies that follow this chapter. It concludes with an outline of this dissertation.

1.1. Introduction

Over the last decade, information technology has handed people a multitude of communication channels. The mobile phone has become virtually indispensable in everyday life, making new friends can be done online by using instant messaging software, and e-mail has replaced traditional snail mail even for official documents such as job applications. New technologies also enable new organizational work structures. For instance, groupware is a technology that provides electronic networks to support communication, coordination, and collaboration across a wide range of service tasks (Orlikowski and Hofman, 1997). This has triggered the virtualization of organizational work teams. Team members can be geographically dispersed, but still work together on documents because of shared document repositories, discussion forums, instant messaging functions, and shared agenda's. However, the use of such technologies is a social process and to be effective in supporting collaboration, all team members must appreciate its value (DeSanctis, Poole, and Dickson, 2001; Venkatesh et al., 2003). If the technology is not used by the intended end users, this undermines the potential benefits. For example, groupware technology allows employees to communicate asynchronously by posting messages on a discussion forum. This can be an effective communication means when two or more persons have conflicting appointments in their agenda's, or are geographically dispersed, and therefore cannot meet face-to-face. The message can be read on a time and location which is of convenience to a team member. However, if some team members do not read the forum or contribute to it, the potentially synergetic effects of this technology are lost. In sum, the adoption of new technology is a precondition for reaping its benefits.

1.2. Technology adoption literature

The academic literature in the field of technology adoption has made an attempt to identify factors that determine employees' and customers' acceptance and usage of new technologies. Among the most important models which have been proposed are the Motivational Model (Davis, Bagozzi, and Warshaw, 1992), the Model of PC Utilization (Thompson, Higgins, and Howell, 1991), and the widely known Diffusion of Innovations Theory (Moore and Benbasat, 1991; Rogers, 1983). Compared to these models, the Technology Acceptance Model (TAM) by Davis and colleagues (Davis, 1986; Davis, Bagozzi, and Warshaw, 1989) has received the most research attention.

This model is appealing for its parsimony and explanatory power (Burton-Jones and Hubona, 2006). One key assumption of TAM is that the perceived usefulness and perceived ease of use of a new technology are the two key determinants of an individual's attitude towards using that technology. This, in turn, is hypothesized to influence the behavioral intention to use a technology. Behavioral intention indicates how hard people are willing to try or to what extent they are planning to make an effort, in order use the new technology (cf. Ajzen and Fishbein, 1980). This behavioral intention is the main driver of actual use. Many studies implicitly assume that technology adoption equals use (De Jong, De Ruyter, and Lemmink, 2003; Venkatesh and Davis, 2000; Venkatesh et al., 2003). However, this dissertation advocates a broader perspective on technology adoption, defining it as "the process of positive attitude formation towards, and usage of a new technology". The reason for doing so is that while users may *use* the technology, they may not really *like* it. Potentially, this affects job attitudes and it can even trigger unfaithful appropriation of the technology, undermining its potential positive outcomes (Brown et al., 2002; Zuboff, 1988).

TAM is based on the Theory of Reasoned Action (TRA), which is one of the most fundamental and influential theories of human behavior (Fishbein and Ajzen, 1975; Venkatesh, 2000). According to TRA, both the *attitude* towards a specific behavior and *subjective norm* have an impact on behavioral intention, which in turn determines actual behavior. An attitude can be defined as a person's negative or positive evaluation of performing the target behavior (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). Subjective norm is an individual's perception that most people who are important to him think he should or should not use the system (cf. Fishbein and Ajzen, 1975, p. 302). One salient difference between TAM and TRA is the exclusion of subjective norm, or social influences, in TAM. The reason for doing so was that, according to Davis et al. (1989) "subjective norm […] is one of the least understood aspects of TRA" and "it is difficult to disentangle direct effects of [subjective norm] on [behavioral intention] from indirect effects via [attitude]" (p. 986). In TAM's successor, TAM2, Venkatesh and Davis (2000) argue that the attitude component mediates only very weakly between perceived usefulness and perceived ease of use on the one hand, and intention to use on the other hand. They therefore exclude the attitude construct from the model. As a consequence, perceived usefulness and perceived ease of use influence an individual's intention to use the new technology directly. Since this takes away the previously mentioned concerns regarding the indirect attitudinal effects on behavioral intention, subjective norm is introduced in

TAM2. Hypothesized relationships include positive effects on the *image* one obtains using the technology, the *perceived usefulness* of the technology, and one's *intention to use* it.

1.3. Social influences and processes in technology adoption

Since the development of TAM and TAM2, numerous replications and extensions of these models have been reported. However, while the importance of social influences on individual technology acceptance behavior has been widely acknowledged, it needs to be further articulated (Lee, Lee, and Lee, 2006). Three reasons can be identified why the role of social processes in technology adoption requires further investigation. First, TAM literature has largely ignored the role of the social context in which individuals adopt technology due to the popular preliminary edition of TAM. This does not include any social component as Davis, Bagozzi, and Warshaw (1989) argued against implementing subjective norm because of its uncertain theoretical and psychometric status. Likewise, the majority of the conceptual models in the field of technology adoption are an extension of TAM and do not take subjective norm nor any other form of social influences into account. This gives rise to a lack of research attention in this topic.

Second, while Venkatesh and Davis (2000) *did* include social influences in TAM2, their approach was low in conceptual and methodological rigor. First, conceptually, the construct of subjective norm is relatively abstract. The description that it is the perception that *most people who are important* to a person *think* that he or she should (not) adopt a technology could be more concrete. For instance, it would be more insightful to assess which source exerts the biggest impact (e.g. a manager, peers, customers, etc.) on an individual's technology adoption decision. However, this decomposed version of subjective norm has rarely been used (notable exceptions are Mathieson, 1991; Taylor and Todd, 1995). More importantly, the conceptualization only addresses normative influences, which masks the underlying social processes by which individuals are influenced. For instance, it is not possible to capture the shared perceptions of a work team on the different social influences.

Third, academic literature on technology adoption has primarily focused on *individual* technology adoption, while social *group-based* factors have been left virtually unexplored. This is remarkable, as more and more companies introduce technologies to support the functioning work teams (Chen and Lou, 2002). Work

teams are an organizational form introduced to facilitate employee collaboration and communication. Inherently, team members influence each other's opinions and attitudes. A team-based work environment thus implies that individuals experience social *influences*, such as subjective norms and social pressure. These social influences may have an impact on social *processes*. For instance, norms and pressure can influence the process of team members integrating their opinions so that they converge to a shared group perception. This conversion is common in team-based work where employees work together interdependently, communicate, and giving each other feedback (cf. Mathieu et al., 2000). Especially in teams where employees are more likely to identify with each other, social psychological theories like the social identity theory (Tajfel and Turner, 1985) predict that social normative influences are *more important* in individual attitude formation. The psychological belonging to a group of people with a common goal means that self-perceptions, beliefs, attitudes and behavior are brought into line with actions and norms facilitating its achievement (Smith, Terry, and Hogg, 2006).

In sum, social influences and processes are relatively underresearched in technology adoption literature and therefore in need of further investigation. Given the trend towards using technology in work teams, the following discussion focuses on interactions between technology and team members in an organizational context. Hence, the in-depth discussion of social influences in a consumer technology adoption setting is outside the scope of this dissertation.

1.4. Technology adoption in the services industry

Technology adoption studies have been conducted both in settings where *employees* interact with technology to optimize business processes (Agarwal and Prasad, 1998; Amoako-Gyampah and Salam, 2004; Venkatesh and Davis, 2000) as well as in settings where *consumers* interact with technology (Bhattacherjee, 2000; Morris and Venkatesh, 2000; Plouffe, Vandenbosch, and Hulland, 2001). Where Davis et al. (1989) study applications such as electronic mail and word processing software, later studies have focused on the adoption of self-service technologies (Dabholkar and Bagozzi, 2002; Meuter, Ostrom, Roundtree, and Bitner, 2000). A customer using a self-service technology, such as an ATM, can experience increased flexibility (e.g. in terms of operating hours) and greater control over the service process, since the service is produced at the moment he or she needs it (Falk, Schepers, Hammerschmidt, and Bauer, 2007; Meuter et al., 2000).

A service can be defined as "any activity or benefit that one party can offer to another that is essentially intangible and does not result in the ownership of anything" (Kotler and Armstrong, 2007, p. 218). Such a "deed, performance or effort" (Jobber, 2007, p. 934) can be carried out by an employee, a team, or a technology. Compared to manufacturing, services are typified by intangibility, inseparability of production and consumption, variability in production and delivery, and perishability which makes services unable to "store" (Jobber, 2007). With the direct involvement of the customer, scholars have recognized that technology infusion in the service delivery process is complex and can have severe consequences when poorly managed. Negative service encounters due to lacking functionality or technology failure will cause customer dissatisfaction and a negative company image (Meuter et al., 2000).

Consequently, both from the field of technology adoption (Venkatesh, 2006) and from the field of service operations management (Roth and Menor, 2003), authors have called for a deeper investigation of the process and consequences of implementing service technology. Also from a more practical point of view, service managers are increasingly interested in providing customized and innovative services, but the combination of "high touch" and "high tech" is yet to be investigated (Roth and Menor, 2003). This dissertation answers these calls from a technology adoption perspective with a specific focus on social influences and processes. The underlying rationale for applying this perspective is the observation that, as a result of direct customer involvement, the adoption of technology-supported service delivery is more socially complex compared to product adoption.

Froehle and Roth (2004) distinguish two broad categories of technology-mediated customer contact: "face-to-face" and "face-to-screen". In the first situation, a customer can interact with a service employee who is supported by technology. A regular airport check-in service is an example. Alternatively, both the customer and the employee interact with the technology, as well as with each other. For instance, conference presentations can be supported by an audience voting system where results are displayed in real-time on a large screen. In both scenarios, multiple parties are involved in the person-technology interaction. As such, verbal remarks, facial expressions, and gestures are very likely to influence people's attitude towards the supporting technology. Hence, social influences are likely to be important in this context. In the face-to-screen category, technology can mediate between customer and employee (e.g. a call-centre for product support), between two or more employees (e.g. a Group Decision Support System), or the service can be provided to

the customer by a self-service technology. In all scenarios, there is a lower media richness compared to face-to-face interactions. The absence of body language, voice tone, and other cues makes it more difficult to assess the risk and the quality of the service delivered (Daft and Lengel, 1984). Hence, users of the technology are forced to rely on substitutive social cognitive processes (Jarvenpaa, Knoll, and Leidner, 1998; Kelly and Jones, 2001).

In sum, technology is one of the primary enablers of new service development, as it supports in responding to heterogeneous consumer desires and demands and also assists in structuring innovation processes *within* organizational boundaries (Johnson et al., 2000). However, technology infusion in service delivery is a field in need of additional research (Roth and Menor, 2003; Venkatesh, 2006). With multiple parties participating in the service delivery process and the importance of social cognitive processes in assessing service risk and quality, the service field displays a more complex picture of social influences and processes compared to a product context. Observing that social elements are so prominent in this setting and technology adoption literature has left this area relatively underresearched, this dissertation investigates social influences and processes on technology adoption in a service context. The central research problem is defined as:

What is the impact of social influences and processes on service technology adoption?

1.5. Focal social processes

As an increasing number of service companies use team-based structures in their daily operations, many use technology to support these teams (Griffith and Neale, 2001). Commonly referred to as groupware, these systems can be used for a large variety of teams and service delivery settings (Duarte and Snyder, 2001). For instance, management teams can use shared agenda's to plan face-to-face meetings, business intelligence teams can pool knowledge in a shared data repository, and global on-site product maintenance teams can enhance decision making by sharing problems and solutions in discussion forums. Therefore, the way in which service firms can use groupware technology varies widely across different service contexts.

Dabholkar (1994) identifies three dimensions to classify the general use of technology in the services industry. First, the service can be delivered to the customer by an employee who is supported by technology. As an alternative, the customer can interact with a self-service technology. Second, the service may be delivered at different locations: at the service site, at the customer's home or work place. Mobile phone services can even be consumed anytime, anywhere. Finally, there may be physical proximity or physical distance between the customer and "service provider" (employee or technology). However, not all technology-supported service deliveries can be easily categorized and there may be additional differentiating factors as well. For instance, the intrinsic difference between for-profit and nonprofit organizations poses several marketing challenges for managing customer relationships (Allison and Kaye, 2005; Gallagher and Weinberg, 1991). In addition, the use of technology in the service delivery may be mandated or voluntary (Brown et al., 2002).

In order to explore the impact of social influences and processes in technology adoption in different service settings, this dissertation first takes a meta-analytical point of view by studing the differential impact of subjective norm across different research settings. Thereafter, the focus is on groupware technology adoption in service delivery and discuss social influences and processes in two specific settings that differ on a number of dimensions. First, university student groups can be supported by a groupware system. The university is public and can thus be characterized as a nonprofit organization. The usage of the technology by the team is important in facilitating the learning process, but not essential, since it does not constitute the only mode of communication between team members. Therefore, this is a situation of voluntary technology adoption. Finally, the users of the system self-produce and self-consume the service. As students develop interpersonal relationships during courses and outside the classroom, they are closely connected to each other, which could easily lead to friction, stress and conflict (Misra and Castillo, 2004). In such a situation, it can be important to focus on whether students dare to speak up, participate in decisions, and feel safe in their group. This dissertation therefore posits the concept of psychological safety to be important in this setting. This reflects the feeling of a student that he/she is able to show and employ himself in his tasks without fear of negative consequences to self-image, social status or school career. In sum, taking psychological safety as the focal variable, an *affective* perspective on service technology adoption is developed. It is generally agreed that an attitude consists of a cognitive component (a set of beliefs), and an affective component (a set of feelings or emotions) (Organ and Konovsky, 1989). For example,

customer satisfaction can be represented by an expectancy (dis)confirmation part, augmented by positive and negative affects in the consumption of a product or service (Oliver, 1993). In this student setting, the affective perspective is considered in relation to attitudes towards groupware technology.

Second, a group decision support system (GDSS) can be introduced to enable multi-team systems of hybrid boundary-spanning service teams in a high-technology company. Where groupware is a broad classification of information and communication technologies that can support groups, a GDSS can be regarded as a type of groupware that is especially targeted towards supporting complex decision processes (Limayem, Banerjee, and Ma, 2006). In this dissertation, this situation is represented by a for-profit organization in which the usage of the technology by the team is essential, since the teams have a high degree of virtuality and meet face-to-face only occasionally. Team members are oftentimes out of office to service products at a client and are dependent on groupware technology for their interpersonal communication and data exchange. Since the team exists because of the technology, this is a situation of mandatory technology adoption. Finally, the users of the system produce the service, but the customer benefits from its "consumption". Since confidence perceptions are regarded to be more important in a setting where technology adoption is mandatory (Brown et al., 2002), this dissertation explores the concept of team confidence perceptions, operationalized by the focal construct of GDSS potency. This reflects the shared perceptions of team members of their joint ability to perform a wide range of service tasks using the GDSS technology. As GDSS potency has its roots in social cognitive theory (Bandura, 1986; Bandura, 1997), a *cognitive* perspective on service technology adoption is developed. In contrast to the previously described setting, emotional responses are expected to be less important in a professional setting where team members are more loosely connected.

1.6. Objectives

This dissertation focuses on social influences and processes in service technology adoption. This problem will be addressed in three inter-related studies. The separate chapters clearly discuss the relevant literature, the used methodology, and the theoretical and managerial implications. Nevertheless, it is important to explicate the outline of the overall objective of this dissertation and how the aims of the different chapters are related to the key objective.

The overall aim of this dissertation is *to determine the impact of social influences and processes on service technology adoption.* To gain better insight in the different types of social influences and processes, relevant socially constructed antecedents of technology adoption in a service setting are identified. The next section formulates specific purposes for the different chapters in which the general objective is assessed from different perspectives.

1.6.1. Objectives Chapter 2

Chapter 2 investigates the role of subjective norm in previous research based on TAM. Studies on TAM reveal mixed and inconclusive findings with regard to the role of subjective norms on technology adoption. While some studies find considerable impacts of subjective norm on dependent variables (Igbaria et al., 1997; Venkatesh and Morris, 2000), other studies do not find such significant effects (Chau and Hu, 2002; Lau, Yen, and Chau, 2001). The objectives of this chapter are to: 1) *provide clarity on the TAM literature with regard to the effects of subjective norms*, and 2) *determine whether the effects are different across research settings.*

1.6.2. Objectives Chapter 3

Chapter 3 further examines the role of social influences and processes in service technology adoption. Using an affective perspective, psychological safety is proposed to be an important social process influencing groupware technology adoption. Drawing on perceived organizational support theory (Eisenberger et al., 1986; Rhoades and Eisenberger, 2002) it is examined to what extent social support determines psychological safety. The objectives of this chapter are: 1) *to develop a conceptual framework of antecedents and consequences of psychological safety*, 2) *to determine whether psychological safety is an important driver of service technology adoption*, 3) *to explore the effects of group-level and individual-level antecedents on psychological safety*, 4) *to investigate whether these effects are contingent on the level of an individual's self-consciousness,* and 5) *to investigate whether the effects of psychological safety on service technology adoption are contingent on the level of offline communication students report.*

1.6.3. Objectives Chapter 4

Chapter 4 examines the role of social influences and processes in the adoption of a GDSS system. In contrast to chapter 3, a cognitive perspective is used. GDSS potency is proposed to be an important social process in service technology adoption. Using social cognitive theory (Bandura, 1986; 1997) and multi-level techniques, the impact of four types of social influences is also taken into account. The objectives of this chapter are: 1) *to develop a conceptual framework of antecedents and consequences of GDSS potency*, 2) *to determine whether GDSS potency is an important driver of service employee performance and GDSS effectiveness*, 3) *to explore the effects of group-level and individual-level antecedents on GDSS potency*, and 4) *to investigate whether these effects are contingent on the level of within-team and between-team cooperation variability.*

1.7. Outline of this dissertation

This dissertation discusses social influences and processes in service technology adoption. In using different theoretical perspectives it contributes to a variety of literature streams. Moreover, it applies advanced statistical data analysis techniques to multiple sources of data. Each chapter contributes to assessing the central research problem of this thesis by discussing the topic from a different perspective. This allows for generalizations as well as relevant contingencies of the impact of social influences and processes on service technology adoption to be identified.

Chapter 2 examines previous research in the field of technology adoption, with a specific focus on the role of subjective norm in TAM-related studies. By using meta-analytical techniques, it gives an overview of what previous academic research has found with regard to the role of subjective norm in technology adoption. Using the sample characteristics of each study used in the meta analysis allows to make statements on the differential impact of subjective norm when results are based on student or non-student responses. Additionally, it is investigated whether the type of technology, i.e. microcomputer or non-microcomputer usage, is of any influence on the significance and effect sizes of subjective norm. Finally, chapter 2 compares studies reporting TAM-based results in Western versus non-Western cultures. Concluding that subjective norm has profound effects on technology adoption, and that managing an individual's social environment is an important management responsibility in the adoption process, chapter 2 sets the stage for a deeper exploration of social influences and processes in chapters 3 and 4.

Chapter 3 discusses social influences and processes in service technology adoption in a context of university student groups supported by a groupware system. Building on organizational learning literature (Edmondson, 2003; Edmondson, Bohmer, and Pisano, 2001) and perceived organizational support theory (Eisenberger et al., 1986; Rhoades and Eisenberger, 2002), an affective perspective is developed to construct an extensive model considering antecedents and outcomes of psychological safety. In doing so, a multi-level analysis approach is taken, differentiating between individual-level and group-level effects of social support antecedents of psychological safety. Multiple teams may develop different group-level assessments of their social environment. This variability is captured by examining whether aggregated group-level perceptions of social support explain incremental variance in an individual's assessment of psychological safety.

Chapter 4 again describes a study on teams adopting a groupware system, more specifically a GDSS, as the topic of interest. However, the setting in which these teams operate differs substantially from the setting in chapter 3. Here, 198 employees of a high-tech company are studied, organized in boundary-spanning service teams. As the adoption of the GDSS has a more mandatory character in this setting, and literature concludes that confidence perceptions are very important in these situations (Brown et al., 2002), chapter 4 employs a (social) cognitive perspective. An extensive model is built, considering antecedents and outcomes of GDSS potency. Again, team shared perceptions may arise, which are captured by means of a multi-level analysis of the determinants of an individual's GDSS potency. As the service is not produced for the GDSS users' own benefits but is delivered to customers, the study does not consider mere usage as an outcome variable, but focuses on GDSS effectiveness. In addition, employee role-prescribed service performance and service innovation support are also considered, as literature suggests that performing both role-prescribed as well as innovative behaviors are important in delivering optimal service delivery (Bunderson and Sutcliffe, 2003; Howell and Shea, 2006; Maruping and Agarwal, 2004).

Chapters 2, 3, and 4 share a number of common features. First, every chapter focuses on technology adoption as defined earlier. The focus gradually shifts from a TAM-based view towards the effective appropriation of technology in work and decision processes. Second, all studies use advanced quantitative techniques for estimating the proposed conceptual model. In chapter 2 we apply meta-analytical statistics. As chapters 3 and 4 deal with a hierarchical data structure as students or employees are

'nested' within teams, the estimations are largely based on a multi-level analysis using hierarchical linear modeling. Third, in chapters 3 and 4, input-process-output (IPO) models are developed and tested in which the different focal social processes (i.e. psychological safety and GDSS potency) are specified as mediators of social influences and technology-related outcomes. An overview of the research studies is given in Table 1.1.

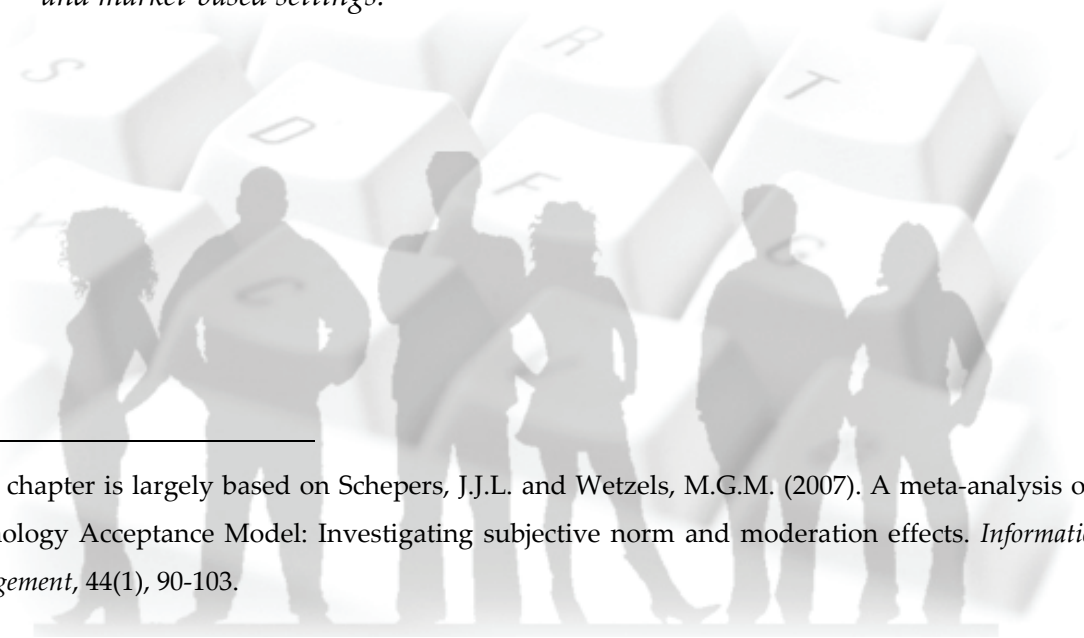
Table 1.1. Overview of the research studies

Chapter	Title	Focal social influence or process	Methodology	Respondents	Setting characteristics
2	A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects	Subjective norm	Quantitative meta-analysis	14.120 respondents from 63 studies	Used studies are differentiated on three types of factors: • Students vs. non-students • Microcomputer vs. non-microcomputer • Western vs. non-Western
3	Psychological safety and social support in groupware adoption: A multi-level assessment in education	Psychological safety	Hierarchical linear modeling and structural equation modeling (SEM)	361 university students organized in 36 teams	• Nonprofit organization • Technology not essential in work process • Voluntary adoption • Service is self-produced and self-consumed
4	Antecedents and consequences of GDSS potency in boundary-spanning service teams: A multi-level assessment	GDSS potency	Hierarchical linear modeling	198 employees of a high-tech company organized in 28 teams	• For-profit organization • Technology is essential in work process • Mandatory adoption • Users produce the service, but the customer consumes

Chapter 2

A meta-analysis of the Technology Acceptance Model: Investigating subjective norm and moderation effects[1]

In this chapter, we conduct a quantitative meta-analysis of previous research on the Technology Acceptance Model (TAM) in an attempt to make well-grounded statements on the role of subjective norm. Furthermore, we compare TAM results by taking into account moderating effects of one individual-related factor (type of respondents), one technology-related factor (type of technology), and one contingent factor (culture). Results indicate a significant influence of subjective norm on perceived usefulness and behavioral intention to use. Moderating effects are found for all three factors. The findings yield managerial implications for both intra-company and market-based settings.



[1] This chapter is largely based on Schepers, J.J.L. and Wetzels, M.G.M. (2007). A meta-analysis of the Technology Acceptance Model: Investigating subjective norm and moderation effects. *Information & Management*, 44(1), 90-103.

2.1. Introduction

While IT can yield many benefits, companies have often had problems when introducing IS into their business processes. According to the Standish Group (Standish Group Inc., 1998), 74% of IS and software engineering projects were delayed, over budget, or failed to meet functional expectations. Researchers and organizations have therefore been trying to find factors that influence an individual's acceptance of IT, thereby ultimately enhancing its usage. In this area, TAM (Davis, Bagozzi, and Warshaw, 1989) is one of the better known models for explaining intention to use a technology. It assumes that the perceived usefulness (PU) and the perceived ease of use (PEOU) are central in influencing a person's attitude and behavioral intention towards using it.

Many studies have replicated, extended, and used TAM but there are some aspects which remain unclear. First, the subjective norm has had a mixed and inconclusive role; it has been defined as "a person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen, 1975). Some studies found considerable impacts of it on the dependent variables (Cheung, Lee, and Chen, 2002; Igbaria et al., 1997; Riemenschneider, Harrison, and Mykytn Jr, 2003). However, others did not find significant effects (Lau, Yen, and Chau, 2001; Roberts and Henderson, 2000). Second, few conclusions have been drawn on the different settings used in testing the model. TAM has been tested with students as subjects (Featherman and Pavlou, 2003; Szajna, 1996) and with non-students (Agarwal and Prasad, 1998; Devaraj, Fan, and Kohli, 2002). It has been applied to microcomputer technologies (Igbaria and Iivari, 1995; Igbaria, Parasuraman, and Baroudi, 1996; Lim, 2002; Lin and Lu, 2000) and other technologies (Chang, 2004; Dyba, Moe, and Mikkelsen, 2004; Koufaris, 2002; Venkatesh, 2000). And it has been used in Western cultures (Agarwal and Karahanna, 2000; Igbaria, Iivari, and Maragahh, 1995; Money and Turner, 2005) and others (Hsu and Lu, 2004; Liaw and Huang, 2003; Teo et al., 2003).

The aim of our study was to examine the convergence or divergence of TAM relationships across different settings to make better claims on and give an objective picture of results of research using TAM in recent years. Since the field has been dominated by quantitative research approaches, we conducted a meta-analysis on the literature, integrating a large volume of results to determine whether research findings were homogeneous. We thus added to two previous meta-studies. Ma and

Liu (2004) also provided a quantitative meta-analysis, but only focused on three relationships: (1) perceived usefulness - perceived ease of use, (2) perceived usefulness - technology acceptance (use), and (3) perceived ease of use - technology acceptance (use). Legris, Ingham, and Collerette (2003) performed a qualitative meta-analysis and concluded that TAM was a useful model, but had to include human and social change process variables (e.g. the subjective norm). In addressing their limitations, we included the subjective norm in our analysis and additionally considered the impact of three types of settings as moderating variables. We also used structural equation modeling to assess overall model fit and identified additional paths to improve the model.

2.2. Research questions

TAM was inspired by the theory of reasoned action (TRA) of Fishbein and Ajzen (1975), which asserted that both the attitude towards an action and subjective norm have an impact on behavioral intention, which in turn affects how people perform the action. An attitude can be defined as the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior (Ajzen, 1991).

TAM was an early attempt to apply psychological factors to IS and computer adoption. It assumed that perceived usefulness and perceived ease of use were major influences of an individual's attitude towards using the technology and thus ultimately relating to actual use. The original TAM did not include subjective norm, however. Nevertheless, social psychologists know that the social context of an individual can change his or her perception of unchanging physical objects (Robertson, 1989).

Being aware of its potential importance, Venkatesh and Davis (2000) hypothesized that subjective norm influenced both perceived usefulness and intention to use in TAM2. Indeed, people often choose to perform an action when one or more important referents say they should, though they do not like or believe in it. This *compliance effect* occurred in mandatory and some voluntary situations. Subjective norm also influences technology acceptance through perceived usefulness, the *internalization effect*. This represents the human tendency to interpret information from important others as evidence about reality.

While the hypothesized subjective norm relationships have been found to be significant in TAM2 studies, other studies have followed TAM guidelines (Robinson Jr, Marshall, and Stamps, 2005; Wu and Wang, 2005). Still other studies included subjective norm, but found it had no significant effect (Chau and Hu, 2002; Lewis, Agarwal, and Sambamurthy, 2003). Our first research question was therefore:

- ***Research Question 1***

What is the overall influence of subjective norm in TAM-based research?

To make more robust claims on the overall role of subjective norm, we also had to study whether sample characteristics had a moderating influence. Furthermore, there is in general a lack of studies investigating the effect of research settings on TAM relationships. We decided to consider the effect of one individual-related factor (the type of respondents), one technology-related factor (the type of technology investigated), and one contingent factor (the country in which the data were collected). Studies were classified into different *categories* according to their conceptual and methodological characteristics and differences in effect sizes of relationships between the categories were examined. The three moderator variables were the only sample characteristics consistently reported in all studies, thus a categorization could be made. Other interesting moderation variables (age, experience, personal innovativeness, or computer self-efficacy), posed practical problems since many studies ignored them.

As a first factor, studies were categorized as using students or not as respondents. A debate exists about the use of student samples in empirical studies (Oakes, 1972; Schultz, 1969). Recently, Peterson (2001) performed a second-order meta-analysis to make more definite claims on the influence of using student samples. He found that the use of students led to different effect sizes, both in direction and magnitude. No clear pattern could be found, however. We therefore formulated the second research question as:

- ***Research Question 2***

What is the influence of using a student sample on the effect sizes of relationships in TAM?

TAM studies have been made in a many technology fields, such as electronic and voice mail (Adams, Nelson, and Todd, 1992), transactional web sites (Aladwani, 2002), electronic supermarkets (Henderson, Rickwood, and Roberts, 1998),

groupware (Lou, Luo, and Strong, 2000), and electronic payment systems (Plouffe, Vandenbosch, and Hulland, 2001). There is however no clear overview of how effect sizes differ with different technologies. For instance, it seems likely that perceived ease of use will play a more important role in new and complex technologies. We therefore formulated a third question:

- ***Research Question 3***

What is the influence of the type of technology on the effect sizes of relationships in TAM?

TAM has also been applied in many different countries: Saudi Arabia (Al-Khaldi and Al-Jabri, 1998), Nigeria (Anandarajan, Igbariam, and Anakwe, 2002), The Netherlands (Gelderman, 1998), Australia (Henderson and Divett, 2003), The United States (Pavlou, 2003), Korea (Suh and Han, 2002), China (Van Raaij and Schepers, 2006), etcetera. It was however shown that TAM did not fit equally well across cultures (Straub, Keil, and Brenner, 1997). Culture is "a system of values and norms that are shared among a group of people and that when taken together constitute a design for living" (Hill, 1997, p. 67). In a three-country empirical study, Straub et al. (1997) showed that effects of perceived usefulness and perceived ease of use were not significant in Japanese e-mail usage. Mao et al. (2005) found that perceived ease of use was more important in Turkey than in the United States when considering mobile phone service adoption. Therefore, we formulated:

- ***Research Question 4***

What is the influence of culture on the effect sizes of relationships in TAM?

2.3. Research methodology

We examined the convergence or divergence of published research results by conducting a quantitative meta-analysis. This integrated the different results of many studies by investigating the intercorrelations of different pairs of variables. For every pair, this yielded an overall effect across studies. In constructing the general effect size, we considered articles published from the publication of TAM in 1989. We searched in all available academic computer databases: ABI/INFORM, Scopus, and ISI Web of Science. Furthermore, Google Scholar, and library catalogues were consulted.

The articles selected had to meet several criteria.

- TAM had to be assessed in an empirical study.
- Integrity of the TAM concept had to be respected: relationships not justifiable by TAM reasoning were absent.
- The research methodology had to be well described, allowing us to collect information for moderator analysis purposes.
- A cross-sectional correlation matrix of the used TAM constructs had to be included as we needed these matrices for our analysis.

Consequently, many studies were excluded from our meta-analysis. One bonus was that this set of criteria addressed the *file-drawer problem*, since journals are likely to publish research results that are statistically significant and thus have effect sizes larger than those that have not and could inflate results (Rosenthal, 1995). No duplication of the articles from the same study in different outlets were included in our sample.

We tested whether the systematic variance in the overall effects could be explained by the research setting of the studies (addressing Research Questions 2, 3, and 4) by performing a moderator analysis, taking into account conceptual and methodological characteristics of the data sets. We collected information on the respondents, the technology under consideration, and the culture in which the study was conducted. After this, we categorized the studies as falling into the category "students" or "non-students". Decisions also had to be made how to classify the technologies used in the different studies. Theoretically, four categories could be defined: specific software applications (word processors, data-base programs etc), internet related technology (search engines, transactional web sites etc), microcomputers, and communications technology (e-mail, mobile technology etc). Unfortunately, comparing these four groups separately was not possible due to a lack of data. We decided to compare the studies concerning microcomputer use with those dealing with other use (Woodrow, 1992). As a contingent moderating factor, culture was considered by making a split between Western (using subjects from Europe, North America, Australia and New Zealand) and other studies from the rest of the world. After categorizing all studies, we determined how overall effects differed between studies by means of a series of Fisher Z-tests.

Finally, we used structural equation modeling with attitude for the original TAM, since we tried to include all correlation pairs possible with the selected studies.

Subjective norm was included for TAM2 because it was expected to influence perceived usefulness and behavioral intention to use.

2.4. Data analysis

2.4.1. Descriptive statistics

A total of 51 useable articles were found, containing altogether 63 studies; of these, 7 were unpublished dissertations or conference proceedings. All articles are listed in the table found in Appendix A. If an article contained multiple studies, it fills more than one line in the table. The table also indicates the categories of each article used in the moderation analysis.

We note that since one article can include multiple studies, statistically interdependent effect estimations may arise, causing a bias in our analysis. For instance, Dabholkar (1996) investigated the use of a self-service option at a fast food restaurant. Using a scenario-based approach, three groups were given different descriptions of the waiting time before being served. These scenario's were treated as three different studies in our sample but do not strictly satisfy criteria for independence of observations. However, aggregating the different effect sizes into one average effect per article would lead to information loss and hence a less accurate picture of the value of the correlation. Since articles with multiple studies are limited in our sample, we consider this disadvantage less severe than that of potential information loss. We therefore treat these studies separately and did not aggregate them.

2.4.2. Correlation analysis

All possible relationships between the 6 constructs in our conceptual model were included in our correlation analyses (yielding a total of 15 pairwise correlations). As can be seen in Table 2.1, all these had been considered at least 7 times in different studies. The relationship between perceived usefulness and perceived ease of use was the most often studied in our sample (53 instances).

From the range of correlation coefficients, it seemed that the strength of each relationship varied greatly: the correlation between perceived ease of use and attitude towards use varied from 0.05 to 0.73. The two relationships most often

falsified were those between subjective norm ↔ perceived ease of use and subjective norm ↔ attitude towards use (50% significant). Given that these relationships were not part of the traditional TAM, this is not surprising. Also, sample sizes of the studies were relatively different: from 35 to 1370.

Table 2.1. Descriptive statistics

Pairwise relationship	# of studies (k)	Range of correlations		Correlations			Range of sample sizes		Cumulative sample size	Average sample size
		lower	upper	# sig	# non-sig	% sig	lower	upper		
SN – PU	24	0.16	0.67	22	2	91.67	43	471	4371	199
SN – PEOU	21	0.10	0.40	14	7	50	43	471	2677	191
SN – ATT	9	0.20	0.64	6	3	50	108	549	1250	208
SN – BI	22	0.15	0.75	19	3	86.36	43	549	3690	194
SN – U	7	0.11	0.48	6	1	85.71	143	471	1889	315
PU - PEOU	53	0.22	0.80	51	2	96.23	35	1370	11538	226
PU – ATT	15	0.29	0.84	15	0	100	66	549	3493	233
PU – BI	38	0.24	0.75	38	0	100	35	549	7054	186
PU – U	23	0.24	0.85	21	2	91.3	35	1370	5788	276
PEOU – ATT	16	0.05	0.73	15	1	93.75	66	549	3244	216
PEOU – BI	40	0.20	0.78	40	0	100	35	549	7151	179
PEOU – U	21	0.18	0.59	19	2	90.48	35	1370	5147	271
ATT – BI	14	0.11	0.75	14	0	100	133	549	3214	230
ATT – U	7	0.16	0.51	7	0	100	108	450	1644	235
BI – U	9	0.25	0.70	9	0	100	35	370	1316	146

ATT = Attitude Towards Use, U = Use, BI = Behavioral Intention, SN = Subjective norm, PEOU = Perceived Ease of Use, PU = Perceived Usefulness

We followed the guidelines of Hunter, Schmidt, and Jackson (1982) in making statements on the overall significance of each pairwise relationship. First, the sample size adjusted mean was calculated (the size-weighted average of individual correlations) as:

$$r_+ = \sum(N_i r_i) / \sum N_i \qquad (1)$$

where N is the total number of participants in each study and r_i the observed correlation in specific study i. Then this mean was corrected for attenuation, since the

effect of measurement error could attenuate the correlation coefficient; i.e. the error of measurement systematically lowers the correlation between variables. The classic formula for attenuation correction is:

$$r_{+c} = r_{+} / (\sqrt{r_{xx}} \sqrt{r_{yy}}) \qquad (2)$$

where r_{+} is the sample size adjusted correlation mean, r_{xx} is the measurement reliability of variable x, and r_{yy} is the measurement reliability of variable y. In most studies coefficient alpha is used as an estimator for r_{xx} and r_{yy}, a practice also applied in our study.

The statistical significance of the correlations was deduced by computing 95% confidence intervals for each mean estimate. These gave an indication of the effect range in the true population, taking into account errors and variation in the calculation of sample effects. Results are displayed in Table 2.2.

Table 2.2. Correlation analysis

Pairwise relationship	r+	r+c	SD	95% confidence interval		Fail-safe N
				lower limit	upper limit	$FSN_{0.05}$
SN – PU	0.370	0.421	0.164	0.353	0.489	27.00
SN – PEOU	0.215	0.254	0.119	0.191	0.316	-7.45
SN – ATT	0.291	0.344	0.168	0.210	0.479	-4.08
SN – BI	0.360	0.419	0.204	0.327	0.511	22.39
SN – U	0.252	0.293	0.162	0.164	0.423	-4.21
PU – PEOU	0.491	0.551	0.180	0.502	0.601	432.57
PU – ATT	0.554	0.669	0.200	0.568	0.771	59.02
PU – BI	0.555	0.630	0.172	0.575	0.684	339.38
PU - U	0.398	0.442	0.157	0.374	0.509	29.55
PEOU – ATT	0.465	0.537	0.252	0.410	0.665	26.29
PEOU – BI	0.413	0.470	0.166	0.418	0.521	135.72
PEOU – U	0.308	0.342	0.129	0.283	0.400	3.47
ATT – BI	0.469	0.549	0.272	0.407	0.692	23.90
ATT – U	0.342	0.413	0.171	0.287	0.540	-2.54
BI – U	0.454	0.536	0.224	0.390	0.682	2.75

ATT = Attitude Towards Use, U = Use, BI = Behavioral Intention, SN = Subjective norm, PEOU = Perceived Ease of Use, PU = Perceived Usefulness

The fact that there are no intervals containing zero suggests that all 15 correlations were significant. However, because the preliminary screening of the significance levels showed that the two relationships involving subjective norm were only significant in half of the studies, we decided to test the significance of our findings further. Therefore, the fail-safe N statistic (or availability bias) was calculated for every correlation (Cooper, 1979; Lipsey and Wilson, 2000) to provide the number of non-significant correlations (studies) that would have to be included in the sample to reverse the conclusion that a significant relationship existed. Table 2.2 shows that the pairwise relationships subjective norm ↔ perceived ease of use, subjective norm ↔ attitude towards use, subjective norm ↔ actual use, and attitude towards use ↔ actual use, do not pass the test, since the fail-safe N was negative. All other pairwise relationships passed the test and were therefore concluded to be generally significant across studies. As perceived usefulness correlated with all other variables and perceived ease of use was only non-significantly correlated with subjective norm, this confirmed the fact that these variables play a key role in determining technology adoption.

2.4.3. Moderator analysis

In order to investigate the existence of moderators, homogeneity estimates (Q) for each relationship were calculated according to the Hedges and Olkin (1985) procedure. This gives an indication of possible moderator effects. The Q-value, which is based on Fisher-Z scores, is compared to a critical value, which is the χ^2 for $\alpha = 0.05$ and k-1 degrees of freedom (k being the number of studies). If the Q-value exceeds the critical value, the biggest outlier is removed from the set of study effects and both values are recalculated. This action is repeated until the Q-value is smaller than the critical value. Table 2.3 shows the number of studies to be dropped for each construct pair to achieve homogeneity. Given the large numbers of studies to be dropped in order to reach homogeneity for most constructs pairs, the hypothesis of homogeneity of study effects was rejected. Nonhomogeneity of study effects suggested the presence of moderator variables.

In order to examine potential moderator variables, clusters of studies were formed based on the material in Appendix A. We distinguished between students (k=28, n=5224) and non-students (k=35, n=8896). A Fisher Z-test was conducted to investigate the significance of the difference between the correlations of the two groups (α=0.05). Table 2.3 shows that the sample population was a significant

Table 2.3. Moderator analysis

	SN - PU	SN - PEOU**	SN - ATT**	SN - BI	SN - U**	PU - PEOU	PU - ATT	PU - BI	PU - U	PEOU - ATT	PEOU - BI	PEOU - U	ATT - BI	ATT - U**	BI - U
Q-value	173.47	36.44	40.18	279.67	45.71	937.07	1076.94	996.92	232.16	442.56	345.20	91.80	933.19	70.99	519.06
Critical value	19.70	18.30	9.49	16.90	5.99	25.00	7.81	15.50	21.00	9.49	33.90	21.00	9.49	9.49	11.10
# dropped	10	3	1	9	3	35	11	29	8	10	17	6	9	2	3
Students	0.55	0.30	0.35	0.42	0.44	0.59	0.84	0.69	0.54	0.58	0.54	0.37	0.62	0.55	0.60
Non-students	0.37	0.23	0.34	0.41	0.26	0.53	0.49	0.56	0.41	0.46	0.42	0.32	0.45	0.23	0.42
Z-value	**6.61**	**1.98**	0.18	0.39	**3.57**	**4.90**	**20.26**	**9.52**	**5.48**	**4.34**	**6.41**	1.58	**6.73**	**7.54**	**4.30**
Microcomputer	0.29	0.15	0.27	-*	0.25	0.54	0.59	0.54	0.43	0.43	0.43	0.36	0.52	0.36	0.81
Non-microcomputer	0.49	0.28	0.35	0.43	0.43	0.55	0.72	0.64	0.45	0.62	0.49	0.33	0.56	0.53	0.47
Z-value	**7.54**	**3.14**	1.06	-*	**3.90**	0.59	**6.43**	**3.51**	0.64	**7.66**	**2.09**	1.02	1.58	**4.01**	**9.02**
Western	0.43	0.24	0.36	0.46	0.27	0.56	0.67	0.67	0.48	0.49	0.46	0.37	0.53	0.41	0.58
Non-western	0.40	0.30	0.30	0.33	0.57	0.54	0.67	0.53	0.38	0.60	0.51	0.30	0.56	0.44	0.26
Z-value	0.87	1.32	1.15	**4.48**	**4.31**	1.35	0.16	**8.73**	**4.68**	**4.76**	**2.08**	**2.74**	1.23	0.62	4.87

** No data was available for the relationship SN-BI in the microcomputer setting*

*** Relationships not passing the fail-safe N test*

moderator for all but three construct pairs (significant Z-values are shown bold). In all cases in which significant moderation effects occurred, correlations were higher for students than non-students.

As a second moderating effect, we labeled studies as dealing with microcomputer (k=14, n=3323) or non-microcomputer use (k=49, n=10705). Following the same procedure, when the Z-value shows significance, correlations are lower in the microcomputer setting. One exception to the observation was the relationship between behavioral intention and actual use. This difference (0.81 ↔ 0.47) was largely explained by the fact that calculations were made on attenuation-corrected correlations. The high 0.81 figure was caused by some relatively low coefficient alphas (around 0.60) of the involved constructs. Osburn (2000) stated that alpha can seriously underestimate reliability of a measure and can therefore, when used in corrections for attenuation, result in nontrivial overestimation of the corrected correlations. It was however not possible to remove the studies with the low coefficient alpha from our study as this would lead to a lack of data. The moderation of the behavioral intention to actual use relationship should therefore be interpreted with care.

As a final moderation test, the total sample was split in Western (k=46, n=8778) and non-Western studies (k=17, n=5342). Table 2.3 shows culture to be a significant moderating variable in about half of the cases, but it is hard to recognize an overall pattern. Subjective norm had a larger impact on behavioral intention in Western studies than non-Western, but when relating subjective norm to actual use, the conclusion reversed. However the latter relationship had not passed the fail-safe N test and was therefore nonsignificant. Furthermore, it seemed that perceived usefulness was key in Western cultures, while perceived ease of use was more important in non-Western studies.

2.4.4. Structural equation modeling

To assess the correlations as a network of interconnected variables and then interpret the fit of the model to the data, we applied structural equation modeling. This tool can be applied in a meta-analytical procedure to estimate structural coefficients on the basis of the correlation matrix obtained from an aggregation of the individual studies (Viswesvaran and Ones, 1995). The core of our model was formed by the classic TAM. Subjective norm was implemented in our model through TAM2, i.e. we

expected subjective norm to influence perceived usefulness via the internalization mechanism, and intention to use via the compliance mechanism. Our conceptual model is depicted in Figure 2.1.

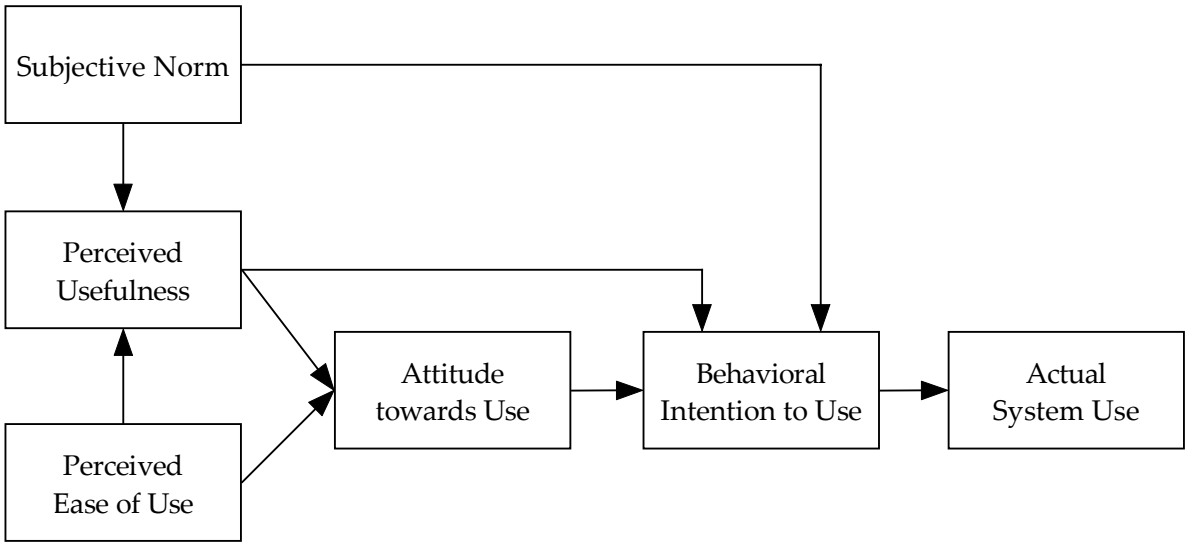


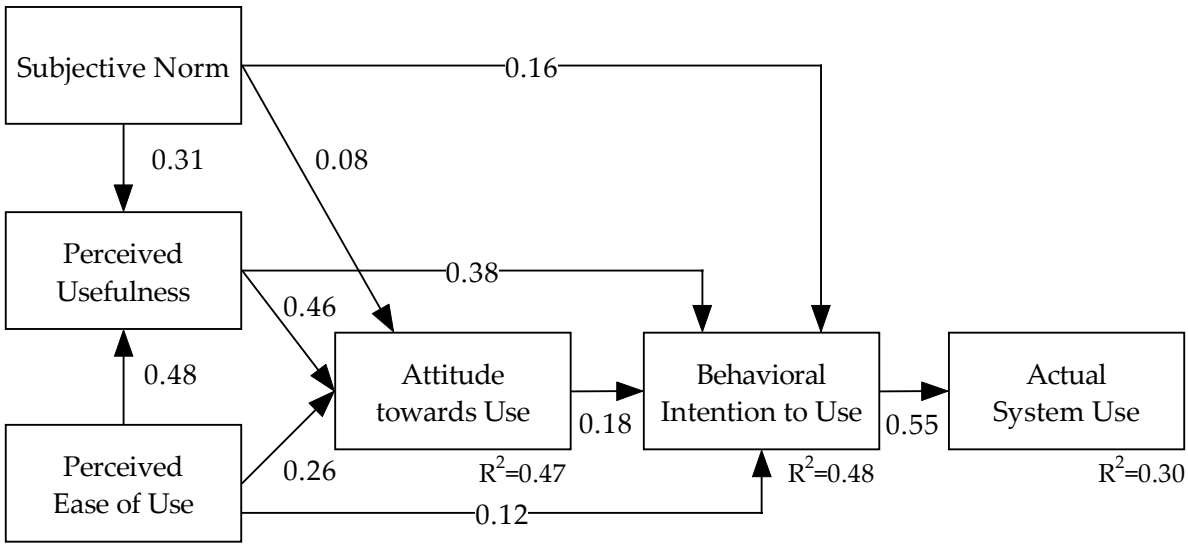
Figure 2.1. Conceptual model for structural equation modeling

We used the correlation matrix as input for LISREL 8.72 (Jöreskog and Sörbom, 1993) and corrected the correlation matrix for attenuation by the James, Mulaik, and Brett (1982) procedure, who suggested setting the relationship between latent variable and (single) indicator to the square root of the reliability coefficient and setting the error term of the indicator to one minus the reliability coefficient.

Our sample size was 1250, which was the minimum sample size for the pairwise relationship of subjective norm and attitude towards behavior. On the basis of the hypothesized model, we found the fair fit of the model to the data: $\chi^2(6)=133.9$, $p<0.01$; TLI=0.90; CFI=0.96; SRMR=0.056. Taking Hu and Bentler (1999) guidelines into consideration, the TLI falls short of the recommended cut-off value of 0.95. This leads us to consider Lagrangian multiplier tests (modification indices). These suggested the inclusion of two relationships: (1) Perceived ease of use → behavioral intention and (2) subjective norm → attitude towards use. Since these relationships had a sound theoretical basis, they may be added to the model. For the first, Davis et al. (1989) had already noted that perceived ease of use had a direct effect on behavioral intention (for time period 1). This questioned the mediating role of attitude, which was therefore usually not considered in later replications of the model. The second relationship was also hypothesized by Davis et al. (1989) based on

Kelman's (1958) work on internalization and identification. When a person perceives that important referents think he or she should use the system, he or she assumes the referent's beliefs, generating a sense of belonging on the part of the user. Although articulated, this proposition was not tested in the original TAM study. Malhotra and Galletta (1999) did test it and found that it had a significant effect.

Given these results, we included both relationships in our conceptual model. Consequently, the model fit significantly improved: $\chi^2(4) = 42.07$, $p<0.01$; TLI=0.95; CFI=0.99; SRMR=0.036. All fit measures now adhered to commonly accepted guidelines. R^2 values were 0.47 for attitude towards use, 0.48 for behavioral intention to use, and 0.30 for actual system use. Figure 2.2 displays the final model, including path coefficients derived from our SEM analysis.



(for all path coefficients, p<0.01)

Figure 2.2. Outcomes of structural equation modeling analysis

2.4.5. Points of attention for meta-analysis

Regarding these findings, a couple of points deserve attention. First, meta-analysis results are constrained by methods used in the primary empirical studies (Brown and Peterson, 1993). Many studies reported findings on TAM using multivariate analyses and meta-analysts have not yet developed effect size statistics that adequately represent such research findings. Second, as apparent in the relationship between behavioral intention and actual use, low coefficient alphas can result in nontrivial overestimation of the corrected correlations. The availability of more data would, of course, cancel out large attenuation-effects. Finally, TAM constructs are often

measured with scales adopted from Davis et al. (1989), Taylor and Todd (1995) or Fishbein and Ajzen (1975). In some cases however, researchers use other scales, sometimes even created for that particular study. Using different scales can, of course, lead to dramatically different results. Unfortunately, a moderation test differentiating on used scales could not be performed in this study, because the number of studies *not* using traditional scales was too small.

2.5. Discussion

The purpose of our effort was to examine the convergence or divergence of research results of many researchers testing and extending TAM, taking into account subjective norm and the influence of different research settings on the produced results.

The original TAM relationships were confirmed. Both correlation analysis and SEM showed the significance of perceived usefulness and perceived ease of use towards attitude and behavioral intention to use. Evidence existed for a stronger dependence of an individual on utility than on lower complexity when adopting new technologies. Both correlations and path coefficients are higher for relationships with perceived usefulness than those with perceived ease of use. TAM literature has investigated this issue. Venkatesh et al. (2003) did not find any direct post-implementation effects of perceived ease of use, only in pre-implementation. This indicates that as users gain experience with a new system, ease of use is overshadowed by other factors.

Large effect sizes (Cohen, 1988) were found for the correlations between subjective norm and behavioral intention (r_{+c}=0.42), and between subjective norm and perceived usefulness (r_{+c}=0.40); they also passed the fail-safe N test. In the structural model, these relationships had coefficients of 0.16 and 0.31 respectively. The smaller effect size for the compliance effect can probably be explained by the fact that this mechanism is only effective in mandatory use settings. Since our dataset contained multiple instances of voluntary technology adoption, the internalization effect was likely to be stronger. Interestingly, although not passing the fail-safe N test, subjective norm displayed a significant effect on attitude towards use (0.08) in the SEM analysis. This identification mechanism was discovered by inspecting the modification indices.

Results indicate that using a student sample seriously affected the relationships. In all but three construct pairs, students displayed a moderating effect, such that the relationships were stronger for students than non-students. We showed a clear pattern of student-based studies displaying stronger effect sizes: arguments from previous research fit in this context. Students are a more homogeneous group than nonstudents and students have a stronger tendency to comply with authority (Sears, 1986). Thus assuming a relatively high amount of early adopters (Rogers, 1983), larger effect sizes of both social and technology-related constructs make sense.

The technology under consideration was found to have a significant moderating effect on the pairwise relationships with correlations being lower in a microcomputer than a non-microcomputer setting. This aligns with findings by Gefen (2003) that for technologies which are familiar, habit explains up to 40% of the variance in intention to use, while other factors are less influential. In these cases, repeated previous behavior dictates current behavior independently of rational assessments (Triandis, 1971).

Comparison of Western versus non-Western studies, 7 of the 15 pairwise relationships were affected. Subjective norm had a larger impact on behavioral intention in Western studies. Taking Hofstede's (1991) cultural dimensions into account, this is an interesting result. In a collectivistic (non-Western) culture one would expect others' opinions to have more impact on the individual because of face saving and group conformity, also a higher power distance would invoke a more influential role for peers. Several studies did find a stronger influence of subjective norm on the intention to perform a focal behavior in non-Western cultures (Choi and Geistfeld, 2004; Lee and Green, 1991). Furthermore, perceived usefulness seemed important in Western cultures, while perceived ease of use had more relevance in non-Western studies. This added to previous findings. Straub et al. (1997) and McCoy et al. (2005) concluded that TAM did not fit non-Western cultural attitudes, while Mao et al. (2005) also concluded that perceived usefulness was less and perceived ease of use more important in non-Western cultures.

2.6. Managerial implications

For managers introducing a technology in their company, efforts should not only be aimed at improving system acceptance at the individual employee level. Given the importance of subjective norm, the department and company as a whole should take

a positive position towards system acceptance. Organization wide support is therefore advised. Probably with a large training program and a permanent help desk with a favorable organizational climate (Agrell and Gustafson, 1996). When considering technology adoption in a consumer market the subjective norm construct is created by word-of-mouth. Managers should realize that a positive or negative 'buzz' can make or break a product in such a situation (Dye, 2000; Lee and O'Connor, 2003).

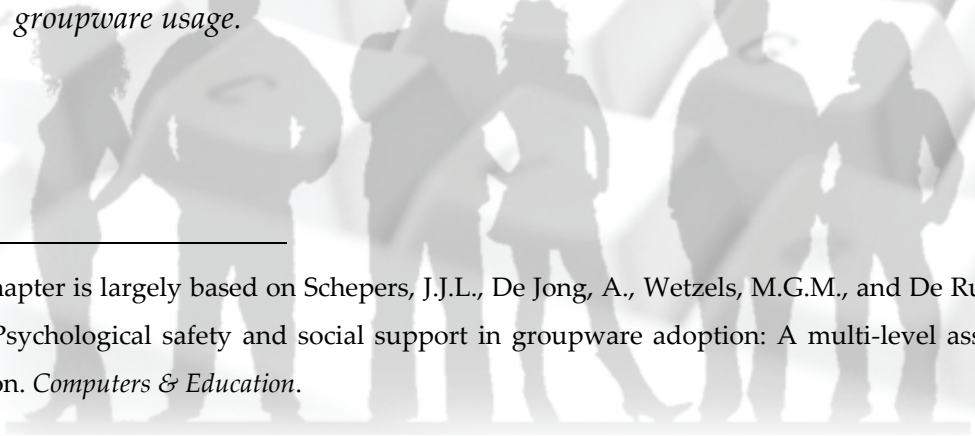
The identified moderation effects yielded valuable implications. Since results showed stronger effects for students, managers need different implementation strategies when aiming at a younger target group. Since they are more technology-ready and sensitive to trends, younger people are more easily influenced by technology characteristics and peer opinions than non-students or older users. Managers should also be aware that as computer usage is so common today, utility, usability, and social aspects are now less important in shaping attitude, intentions and behavior.

Finally, managers should be aware that the technology adoption process differs per culture. In Western cultures, perceived usefulness seems to be more important in determining intentions and actual use, while ease of use is key in non-Western cultures. Communication regarding the introduction of the technology, like training manuals, advertising campaigns, face-to-face contact, should therefore carry different messages dependent on the culture in which the technology is to be used.

Chapter 3

Psychological safety and social support in groupware adoption: A multi-level assessment in education[2]

In this chapter, we propose that psychological safety, a sense of interpersonal trust and being valued in a work team, is an important determinant of groupware technology adoption in an educational setting. We develop and test a model of antecedents and consequences of psychological safety. Data were collected from 361 university students, organized in 36 teams. Results of multi-level regression analysis reveal positive individual-level effects of perceived tutor support and perceived peer support on psychological safety. Furthermore, our findings show a positive unique group-level effect of perceived tutor support on psychological safety, where an individual's level of self-consciousness strengthens this positive impact. In addition, findings of structural equation modeling demonstrate that both perceived usefulness and perceived ease of use partially mediate the positive effect of psychological safety on groupware usage. Psychological safety also shows a positive direct effect on groupware usage. Finally, a student's offline communication frequency with his tutor and peers appears to strengthen the impact of psychological safety on perceived usefulness, perceived ease of use, and groupware usage.



[2] This chapter is largely based on Schepers, J.J.L., De Jong, A., Wetzels, M.G.M., and De Ruyter, K. (in press). Psychological safety and social support in groupware adoption: A multi-level assessment in education. *Computers & Education*.

3.1. Introduction

A growing variety of organizations implement groupware technologies to improve collaboration in their group-based organization structures (Chen and Lou, 2002). Groupware technologies "provide electronic networks that support communication, coordination, and collaboration through facilities such as information exchange, shared repositories, discussion forums, and messaging" (Orlikowski and Hofman, 1997, p. 12). One major benefit of groupware is that it helps team members to overcome geographical and time constraints when interacting/communicating with each other (Benbunan-Fich, Hiltz, and Turoff, 2002). In education, e-learning systems and virtual learning environments enable improvements in communication efficiency between student and teacher, as well as among students working in groups (Martins and Kellermanns, 2004). These technologies also allow competence-based learning in flexible co-operative groupings and can result in qualitatively more supportive and productive learning processes (Mooij, 2004).

Despite the potential benefits, many groupware technologies are underutilized or abandoned completely (De Vreede, Davison, and Briggs, 2003; Fjermestad, 2004). Evidence in literature suggests that (the lack of) interpersonal trust may be a key factor in groupware adoption. For instance, Kelly and Jones (2001) argue that personal bonds, established relationships, and social contacts are of utmost importance for successful implementation of groupware technology in a financial service company. Similarly, Brown et al. (2004) state that medical practitioners' resistance to telemedicine can be overcome by establishing trusting relationships between involved parties. Groupware induces a certain degree of virtuality, which reduces the number of tacit clues for an individual to estimate the risk of exploitative behavior by the others. Additionally, introducing technology in an educational environment can dramatically change both teachers' and students' roles (Mooij and Smeets, 2001). This forces individuals to increasingly rely on each other, while being subject to others' potential social loafing, flaming attempts (i.e. posting hostile or insulting digital messages using the system), or other undesired actions and consequences. Therefore, additional time and effort must be spent monitoring colleagues or fellow students, backing up or duplicating each others' work, and documenting problems (Wilson, Straus, and McEvily, 2006). This leads to extra costs and decreased work effectiveness and productivity (McAllister, 1995). As a result, collaboration using computer-mediated technologies can only be effective if all

parties are willing to open themselves to one another in order to jointly carry out a task, solve problems, and learn (Jarvenpaa, Knoll, and Leidner, 1998).

So far, researchers have focused much of their attention on outcome criteria of groupware systems (Eden and Ackermann, 1996), such as participation (Dennis and Garfield, 2003), efficiency (Dennis, Hayes, and Daniels, 1999), knowledge transfer (Chen and Shaw, 2006) and learning effects (Rada, 1998; Veen, Lam, and Taconis, 1998). Despite the role social-psychological factors (e.g. interpersonal trust, social support, level of communication) play in achieving these outcomes, they have been largely ignored in explaining groupware *adoption* (Dennis and Reinecke, 2004). This study addresses this research gap in an educational setting, making the following contributions to literature.

First, we enrich the existing scope of groupware adoption in an educational setting by incorporating trust-based student-team dynamics into our study, proposing psychological safety to be an important determinant of groupware adoption. Psychological safety can be defined as the feeling of a student that he is able to show and employ himself in his tasks without fear of negative consequences to self-image, social status or school career (cf. Kahn, 1990). Where interpersonal trust typically reflects mutual confidence (Jones and George, 1998), psychological safety is a broader construct that also encompasses a sense of being *valued* and *comfortable* in that setting. The concept has been introduced in organizational learning literature relatively recently, and has predominantly been assessed in a medical context (Edmondson, Bohmer, and Pisano, 2001; Edmondson, 2003; Lee et al., 2004; Nembhard and Edmondson, 2006; Tucker, Nembhard, and Edmondson, 2007; Wilkens and London, 2006). However, psychological safety has also displayed positive effects in business settings, enhancing employee engagement at work (May, Gilson, and Harter, 2004), team learning behavior (Carmeli, 2007; Edmondson, 1999), and firm performance (Baer and Frese, 2003). Despite the fact that psychological safety may be critical in a groupware supported student team, where social loafing, flaming, and/or bullying might occur, its role has not yet been empirically substantiated in an educational setting. Additionally, in studies on e-learning adoption, the focus has primarily been on system characteristics and individual traits (Chiu et al., 2005; Pituch and Lee, 2006; Van Raaij and Schepers, 2006), while interpersonal and group processes have not received much research attention. Our study addresses this research gap.

Second, previous literature offers little guidance on the impact of different types of determinants of psychological safety in groupware adoption. Past studies have demonstrated that social support is of key importance in situations that are characterized by a lack of tacit cues (Wiesenfeld, Raghuram, and Garud, 2001). So far, however, the impact of supportive conditions on individuals' safety perceptions has been left virtually unexplored. Therefore, we will focus on the impact of social support on psychological safety, using perceived organizational support theory (Eisenberger et al., 1986; Rhoades and Eisenberger, 2002). In our educational context, this theory would predict that students perceiving high social support are in a better study mood and suffer fewer strain symptoms, i.e. feel safer. In addition, education has been classified as a multilevel system where characteristics between different levels (individual, small group, class, etcetera) may interact over the course of time, yielding a complex picture of effects which can influence learning processes and outcomes (Mooij, 2004). Especially the use of groupware implies that students work in teams. As the students work together, individual perceptions on the level of support are likely to converge, so that each team develops its own typical shared view on support (Kozlowski and Klein, 2000). Hence, besides individual differences on support perceptions, also differences between teams are likely to arise (Mathieu et al., 2000). Consequently, recent research has shown a growing interest in the question of whether typical individual-level findings are representative of corresponding higher-level relationships (Dineen et al., 2007). We therefore examine whether group-level (i.e. aggregated) perceptions of social support explain incremental variance in students' individual assessments of psychological safety.

Third, there has been an important tradition of studying person-situation interactions in psychology (Endler and Magnusson, 1976), which has also been established for understanding support judgments (Lakey et al., 1996). Organizational behavior literature has indicated that the impact of supportive conditions on individual's work-related perceptions typically depends on individual traits. For instance, Colbert et al. (2004) report that the relationships between perceived social support and interpersonal workplace deviance is moderated by agreeableness. In this study we test whether the relationship between support and psychological safety is moderated by the individual trait of self-consciousness.

Fourth, studies have suggested that groupware is most efficient when used as supplementing, and not a supplanting mode of contact for teams involved (Benbunan-Fich et al., 2002; Dennis and Reinecke, 2004; Kelly and Jones, 2001).

Hence, the amount of offline communication supporting the online processes could be an important precondition of successful groupware adoption. While the moderating impact of communication frequency has been extensively investigated in social sciences (Kacmar et al., 2003; Becerra and Gupta, 2003), it has hardly received attention in the context of IT adoption relationships. We therefore test the moderating role of offline communication frequency in our framework.

To address these issues, we structure our article as follows. We begin with a literature overview of psychological safety. Next, we build our conceptual model. In addition, we empirically test the specified hypotheses, and discuss the results. We end up with future research directions and limitations of the study.

3.2. Literature review

Safety beliefs are rooted in Maslow's (1943) classical work, describing human behavior to be motivated by a set of five goals (i.e. basic needs) arranged in a hierarchy of prepotency. After satisfying one's primary need of hunger and thirst (or the possibility to do so), an individual strives to be protected against physical and mental threats. Parents and the normal family setup are indisputable mechanisms for supplying love and care in this respect. Reflecting Maslow's thoughts on the current everyday practice in organizations, employees need a safe work environment in order to be able to motivate themselves to strive for higher order goals.

Physically safe and healthy work conditions have received some attention in organizational behavior literature. For example, Zohar (2000) empirically shows that when an individual perceives a climate to be more safe, this reduces the injury rate within an organizational subunit. However, *mental* safety (i.e. psychological safety) is a relatively new concept which has received research attention only very recently (May et al., 2004). An individual experiences psychological safety when he/she feels able to show and employ himself/herself without fear of negative consequences to self-image, status or career (Kahn, 1990). People feel mentally safe in an organization if speaking up to colleagues or fellow students will not lead to personal harm or rejection. This should hold true for all types of discussions, ranging from a personal conversation to addressing flaws in work processes.

Edmondson (2004) argues that individuals perform tacit calculus at micro-behavioral decision points, assessing the interpersonal risk of a certain behavior in a specific

situation. They ask themselves the question whether they will be criticized or embarrassed if they perform behavior X in situation Y. Since the behavior of people in an individual's environment plays an important role in making this decision, the concept of psychological safety is closely related to the construct of interpersonal trust. Both constructs describe the willingness or likeliness of vulnerability to others' actions, but psychological safety goes beyond interpersonal trust (Edmondson, 2004), since it also encompasses a sense of being valued and comfortable in that setting. This can be of utmost importance in using a groupware system, since less face-to-face contact simplifies displaying opportunistic behavior for team members. Not contributing equally to the group's processes (social loafing) or posting insulting messages (flaming) can also occur (Alonzo and Aiken, 2004). Research has shown that conflicts easier arise and escalate using digital forms of communication compared to face-to-face communication (Friedman and Currall, 2003). Feeling safe in one's work or study environment and being valued by team members can diminish this polarization.

Psychological safety can be regarded as a psychological climate: a property of individuals denoting their perception of the psychological impact that the work or study environment has on his or her personal well-being (James and James, 1989; Schneider and Reichers, 1983). Proponents of psychological climate theory posit that individuals respond primarily to cognitive representations of environments "rather than to the environments per se" (James and Sells, 1981). Each individual constitutes his or her own psychological climate of the same environment. Perceptions may nevertheless differ based on personal belief systems and individual biases. We therefore consider psychological safety to operate on the individual level.

3.3. Research model and hypotheses

3.3.1. Organizational support

In this section, we use perceived organizational support theory (Eisenberger et al., 1986; Rhoades and Eisenberger, 2002) to discuss those supportive organizational conditions that serve as antecedents of psychological safety. Perceived organizational support theory is often applied in organizational behavior literature (Rhoades and Eisenberger, 2002), and states that to meet socio-emotional needs (e.g. feeling safe), employees develop global beliefs concerning the extent to which the organization values their contributions and cares about their well-being (Eisenberger et al., 1986).

Individuals who perceive the organizational support to be high find their job more pleasurable, are in a better mood performing their tasks, and suffer fewer strain symptoms like anxiety (Rhoades and Eisenberger, 2002).

Perceived organizational support theory distinguishes two major types of organizational support variables: perceived supervisor support and perceived peer support (cf. Eisenberger et al., 2002). A supportive context basically entails three major aspects: rewards, coaching, and information (De Jong, De Ruyter, and Wetzels, 2005). Obviously, these aspects carry a different content in an educational setting compared to a business setting. Where rewards are oftentimes monetary in business, students mainly get rewards from fellow students' appreciation or from obtaining higher grades. Where coaching and information can take on the form of meetings discussing personal progress in companies, students obtain personal or class feedback from tutors (as the equivalent of supervisors) and fellow students. Hence, in an educational setting, support can be received either from a student's tutor or from peers.

Edmondson (2004) argues that if a leader is accessible and approachable for subordinates, people feel more comfortable in their work environment. Furthermore, when interpersonal relationships in someone's work environment are supportive, open, and respectful, they have a major impact on feelings of safety (Edmondson, 2004; May et al., 2004). This holds especially true for relationships across different hierarchical echelons, since these are traditionally regarded as more stifling and threatening than relationships with peers (Kahn, 1990). May et al. (2004) also empirically show peer relations and supervisor relations to positively influence psychological safety. Translating these findings into an educational context, we would expect that supportive inter-student relationships as well as supportive tutor-student relationships affect psychological safety. Hence, we state:

- *H1. Perceived tutor support positively influences a student's assessment of his psychological safety.*
- *H2. Perceived peer support positively influences a student's assessment of his psychological safety.*

3.3.2. Group-level effects

With education typically being a multilevel system, technology can help to design, integrate, record, and regulate instructional and learning processes across different organizational levels (Mooij, 2004). While students can use groupware individually, for instance to download lecture slides, the technology also supports team communication and cooperation. Since a student team jointly uses the groupware to collaborate, members of the team influence each other in their perceptions towards the technology and their study environment in general. While these perceptions may be divergent upon starting a project, interpersonal processes and social dynamics cause individual beliefs to converge, resulting in a shared team view (Kozlowski and Klein, 2000). As such, researchers have proposed that individual team-member perceptions can meaningfully be aggregated to a team level of analysis (Mathieu et al., 2000; Chen and Bliese, 2002). These aggregate-level constructs represent synergetic, social processes of individuals within teams that are not captured by their individual-level equivalents and might therefore have a differential impact on psychological safety perceptions.

When students in a group study and learn together, communicate, and give feedback, they integrate their opinions, constituting a shared perception of their supportive conditions of their study environment (cf. Mathieu et al., 2000). For instance, while an individual student may think that social support is relatively low, other team members can have a different opinion. As such, students influence each other to construct joint opinions on the level of social support. The student with initial negative perceptions may slightly adjust them to be more consistent with the group's view, but the shared group perception will still differ from individualized opinions. Since social dynamics among group members converge individual perceptions, and support from supervisors and tutors is often directed at the group instead of the individual (Chen and Bliese, 2002), it is meaningful to discriminate between individual-level influences and group-level influences of social support on psychological safety. Consequently, we adopt an approach that analyzes the influence of predictor variables at two levels.

Following the majority of studies, our group-level operationalization of antecedents is based on the direct consensus model, where the group-level variables reflect aggregates of the individual scores (cf. De Jong, De Ruyter, and Lemmink, 2004). This entails that the relationship between the antecedents and psychological safety is

primarily hypothesized at the individual level. However, additional hypotheses H3a and H3b are included to examine whether the group level aggregates yield additional, differential, effects to the explanation of psychological safety. Therefore, we hypothesize that:

- *H3a. At the group-level of analysis there is a positive effect of perceived tutor support that accounts for a significant amount of additional variance in psychological safety.*
- *H3b. At the group-level of analysis there is a positive effect of perceived peer support that accounts for a significant amount of additional variance in psychological safety.*

3.3.3. The moderating role of self-consciousness

In organizational behavior literature, individual traits are frequently considered as moderators of relationships including psychosocial variables, as they adequately capture the variation in employee differences (Dabholkar and Bagozzi, 2002). These traits may serve as discretionary stimuli that differentially influence individuals' perceptions of team social processes, producing systematic variation in its ratings (Hackman, 1992). As we expect a differential impact of group-level predictors of social support on psychological safety above individual-level predictors, we are interested in whether these synergetic effects hold for different types of students. We propose that in an educational setting, the individual trait of self-consciousness moderates the relationship between the support variables and psychological safety. Self-consciousness can be defined as "a person's view of himself or herself as a social object, with an acute awareness of other people's perspectives about him or her" (Dabholkar and Bagozzi, 2002, p. 189). This trait typically comes into play in situations which are characterized by social risk (May et al., 2004), since exposure to opportunistic actions of others may considerably lower feelings of interpersonal trust. In a study environment, self-consciousness could be particularly relevant, since being bullied or becoming an outcast can seriously affect current study results, future productivity as a company employee, and even the tendency towards displaying delinquent behavior (Harvey et al., 2006; Veenstra et al., 2005).

Students who feel highly self-conscious are afraid to be judged as different, and are therefore engaged by the work of managing impressions (Kahn, 1990). Adhering to shared perceptions is a vehicle for doing so. As a consequence, students who feel self-conscious about using groupware technologies might be more inclined to consider shared opinions about support from their tutors and their peers in their

assessments of psychological safety. In contrast, team members who score low on self-consciousness care less about adhering to shared opinions since they do not fear being watched and judged in their personal routine. Therefore, we hypothesize:

- *H4a. At the group level of analysis, the positive effect of perceived tutor support on psychological safety is stronger for students with a higher self-consciousness.*
- *H4b. At the group level of analysis, the positive effect of perceived peer support on psychological safety is stronger for students with a higher self-consciousness.*

3.3.4. Outcomes of psychological safety

Existing studies have associated psychological safety with team learning behavior and team performance (Edmondson, 1999), firm goal achievement and return on assets (Baer and Frese, 2003), personal engagement at work and job involvement (Brown and Leigh, 1996; Kahn, 1990; May et al., 2004), and face giving (Tynan, 2005). Edmondson et al. (2001) show psychological safety to play a critical role in the successful adoption of a new surgery technique in hospitals by members of ER teams. Teams characterized by a higher degree of psychological safety displayed more effective and satisfactory use of the new technology, compared to teams where people did not feel safe. Furthermore, Edmondson and Woolley (2003) demonstrate that psychological safety has a positive impact on the acceptance of an organization-wide change program in a large manufacturing company. These findings imply that psychological safety reduces defensiveness and "learning anxiety" in uncertain and unknown situations (Schein, 2004).

Particularly the introduction of groupware is an example of an uncertain situation, as it relates to the shift to new communication structures and document exchanges (Mooij and Smeets, 2001). This gives new users the opportunity for misusing the system for flaming or social loafing. However, if students feel valued by their peers and are comfortable in their environment, the risk of opportunistic behavior will be judged as minimal and they do not have trouble speaking up in case of difficulties or problems. Consequently, more positive perceptions towards the groupware technology will be sparked.

Traditionally, technology adoption literature has emphasized perceived usefulness and perceived ease of use as the most important determinants of technology adoption (Davis, Bagozzi, and Warshaw, 1989; Venkatesh and Davis, 2000). Other

factors that potentially influence groupware adoption, are considered to influence technology adoption only indirectly via these two determinants (Davis et al., 1989). We therefore hypothesize that students with higher levels of psychological safety will be more positive about the groupware's utility, since its potential is not obstructed by the risk of undesired behaviors of others. These students will also perceive the technology to be easier to use since complications in system usage will be voiced and dealt with immediately. We therefore hypothesize:

- *H5. A student's assessment of his psychological safety positively influences his perceived usefulness of the groupware technology.*
- *H6. A student's assessment of his psychological safety positively influences his perceived ease of use of the groupware technology.*

3.3.5. The moderating role of offline communication frequency

Communication frequency describes how often an individual engages in a process of sharing and creating information in order to reach a mutual understanding (Johnson and Lederer, 2005). In psychology and organizational behavior literature, clear and sufficient communication between managers and subordinates, as well as between peers, is often heralded as being critical in change processes, including the introduction of technology (Chawla and Kelloway, 2004; Wanberg and Banas, 2000). Some recent studies in these fields have emphasized the importance to model the moderating impact of communication frequency in performance relationships. Kacmar et al. (2003) show a moderating effect of communication frequency on the relationship between leader-member exchange (LMX) and job-performance ratings. When low frequencies of communication limit feedback and developmental attention, uncertainty arises, leaving employees unable to translate their high-quality relationship into improved performance. Becerra and Gupta (2003) argue that with greater frequency of communication positive characteristics of the environment (e.g. safety) become more visible to employees and therefore have larger impact on their job performance and evaluations.

In the context of groupware, studies suggest that a certain amount of *offline* communication should supplement the online communication processes to enable groupware adoption and successful use (Benbunan-Fich et al., 2002; Dennis and Reinecke, 2004; Kelly and Jones, 2001). Therefore, in our study, the outcomes of psychological safety might be contingent on the level of offline communication

frequency a student exercises with his/her peers and tutor. When offline communication levels increase, it is easier for fellow students to explain and demonstrate the functioning of a technology. Likewise, several studies have shown related processes, such as individualized training, coaching, and support, to reduce feelings of technological complexity (Schillewaert et al., 2005; Venkatesh, 1999). Additionally, frequent offline communication helps students understand to what extent technology can support study processes (Johnson and Lederer, 2005; Lind and Zmud, 1991). Effort saved due to improved communication and lower uncertainty may be redeployed to interacting with the technology, enabling a person to have more positive technology perceptions for the same level of effort (cf. Davis et al., 1989, p. 987). We therefore hypothesize that an appropriate level of offline communication frequency both with one's peers as well as with one's tutor are preconditions for reaping the benefits of psychological safety. Hence, we posit,

- *H7a. The positive effect of psychological safety on perceived usefulness is stronger for students with a high offline communication frequency among peers.*
- *H7b. The positive effect of psychological safety on perceived ease of use is stronger for students with a high offline communication frequency among peers.*
- *H8a. The positive effect of psychological safety on perceived usefulness is stronger for students with a high offline communication frequency with the tutor.*
- *H8b. The positive effect of psychological safety on perceived ease of use is stronger for students with a high offline communication frequency with the tutor.*

3.3.6. Perceived usefulness and perceived ease of use

Traditionally, technology adoption literature has emphasized the key roles of perceived usefulness and perceived ease of use in introducing new technologies, due to the popularity of the Technology Acceptance Model (TAM) (Davis et al., 1989; Venkatesh and Davis, 2000). In general, these two technology perceptions have constituted a significant influence on an individual's intention to use a technology or system (Schepers and Wetzels, 2007). The mediating role of attitude between these perceptions and behavioral intention has been doubtful from the start of TAM and has therefore not been considered in later assessments of the model (Venkatesh and Davis, 2000). Consistent with research trends and empirical findings in the field of technology adoption, we therefore hypothesize:

- *H9. A student's perceived ease of use of the technology positively influences his perceived usefulness of the technology.*
- *H10. A student's perceived usefulness of the technology positively influences his groupware usage.*
- *H11. A student's perceived ease of use of the technology positively influences his groupware usage.*

The hypotheses described above form our conceptual model, depicted in Figure 3.1.

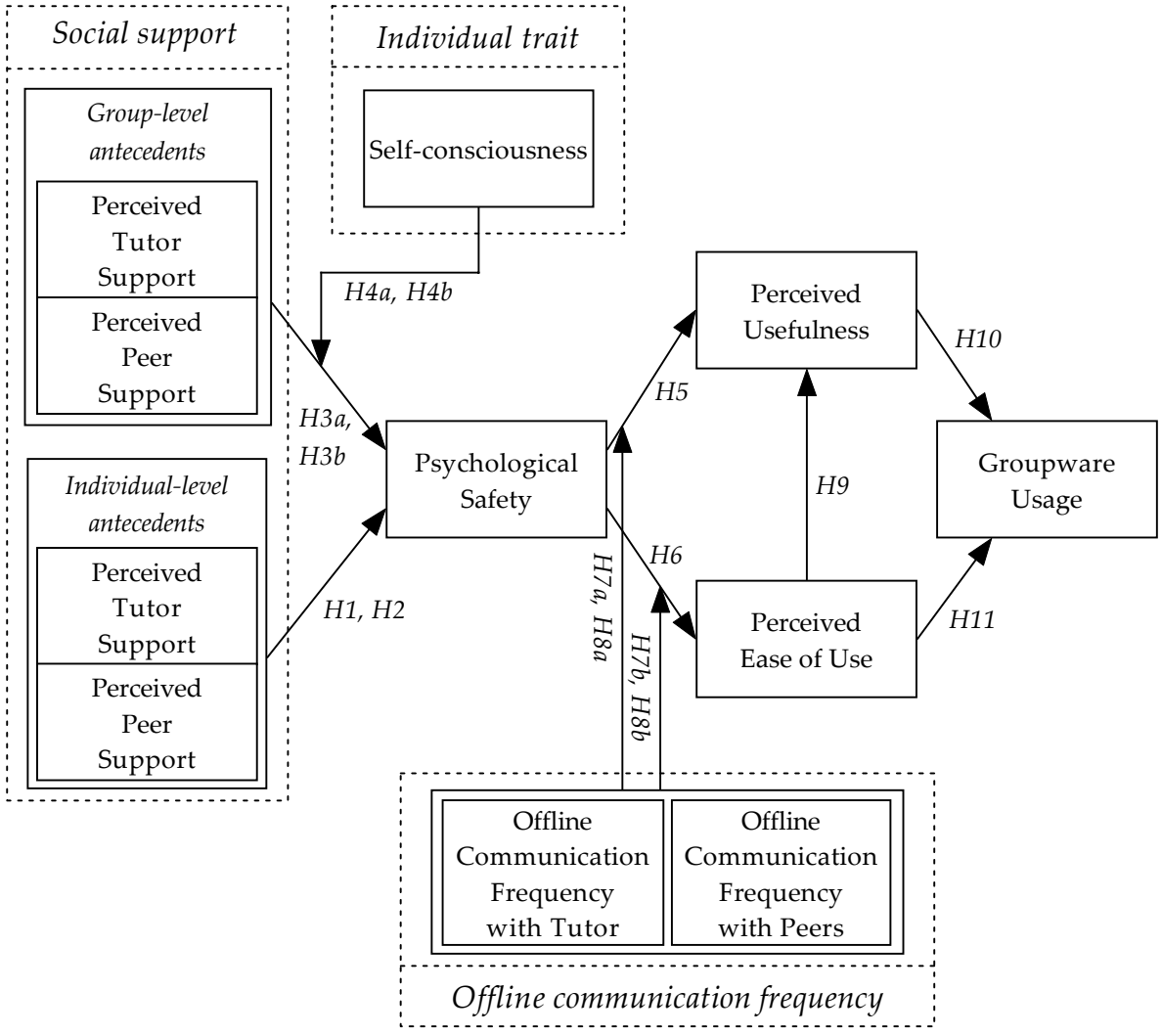


Figure 3.1. Antecedents and consequences of psychological safety

3.4. Methodology

3.4.1. Data collection and sample characteristics

We created an experimental groupware setting for Dutch university students. For a course on management of organizations, students were clustered in groups of 5 to 15 members. Each student fulfilled weekly assignments, and was encouraged to use fellow group students to increase and improve his own insights. In past years, students mostly communicated face-to-face and through e-mail. We now supplied a number of student groups with a supporting tool for collaboration specifically designed for this research. This groupware enabled students to exchange documents, ask questions via forums and chat boxes, access online information resources, obtain lecture slides, and read the latest news on the course. Besides the new experimental communication platform, 12 two-hour tutorial group meetings were scheduled during the eight-week course.

The implicit goal of the offline sessions was to enable effective learning in small groups, and each student was expected to contribute to group discussions. As an incentive to do so, active participation was rewarded with bonus points added to the overall course grade. The tutorial group meetings were chaired by a tutor, with each group consistently assigned the same tutor. Tutors were expected to stimulate discussion and creativity, guide discussions when necessary, stimulate a thorough analysis of assigned student tasks, and formulate relevant learning goals. Furthermore, he or she acted as a contact person for a wide range of student problems and questions. Since students were working in groups, were dependent on one another for successful completion of the course, were influenced by a tutor both inside and outside their tutorial sessions, and their work involved using groupware, the setting above is regarded as a suitable research context for our study.

Data were collected by means of a questionnaire, distributed by tutors in the break of the second-to-last two-hour tutorial session. Of the 869 questionnaires distributed, 361 completed questionnaires were recollected, yielding a response rate of 41.5%. Of these 361 respondents, 251 (69.5%) were male, 110 (30.5%) were female. The minimum age was 17 years, the maximum age 33 years. The average age was 19.43 years with a standard deviation of 1.64 years.

3.4.2. Measurement

All latent constructs, except for groupware usage, were operationalized by multi-item scales validated in previous studies. Participants indicated their (dis)agreement with a set of statements using a 7-point Likert-type scale that ranged from strongly disagree to strongly agree. Psychological safety was measured with 5 items adapted from scales by Edmondson (1999) and May et al. (2004). Perceived tutor support and perceived peer support were both assessed with 4 items adapted from Eisenberger et al. (1986). Self-consciousness was measured with 3 items adapted from Fenigstein et al. (1975). The constructs offline communication frequency with peers and tutor were operationalized by 3 items each, which were adapted from Johlke and Duhan (2000) and Johlke, Duhan, Howell, and Wilkes (2000). The 4 traditional items proposed by Davis et al. (1989) for both perceived usefulness and perceived ease of use were used in this study. Finally, groupware usage was operationalized with 3 newly developed items, each measuring the frequency of accessing one specific software component of the groupware. The items assessed the frequency of accessing the groupware's shared documents repository, contributing to the discussion forum, and the usage of the group messaging function. In contrast to other scales, respondents answered the questions on a scale ranging from "never" (1) to "more than once a day" (7).

3.5. Data analysis and results

3.5.1. Validity and reliability

To verify the validity and reliability of the measures we conducted a confirmatory factor analysis (CFA; Anderson and Gerbing, 1988) at the individual level of analysis. Using the robust maximum likelihood estimator in AMOS 5.0 (Arbuckle, 2003) revealed an acceptable fit to the data: $\chi^2(459)=806.16$ ($p<.001$); TLI=0.93; CFI=0.94; RMSEA=0.05; SRMR=0.05. All items loaded significantly on the hypothesized latent variables to provide evidence for convergent validity (Anderson and Gerbing, 1988). Using the robust standard errors, we calculated 95% confidence intervals for the estimates of the intercorrelations among the latent variables to assess discriminant validity. For all possible correlation pairs, the value one was not included in the interval, indicating discriminant validity (Anderson and Gerbing, 1988). We also assessed the change in χ^2 when fixing covariance paths to one consecutively in our structural model. When the fit significantly decreases, the pair of constructs can be discriminated. For all construct pairs, model fit significantly decreased, yielding further evidence for discriminant validity. Finally we calculated the composite

reliability for each latent construct to assess the reliability of our scales. Since all values exceeded the commonly accepted threshold of 0.70, we conclude that our measures are reliable. Table 3.1 shows the details of the analyses above.

Table 3.1. Construct reliability and validity measures

Construct Item	**Mean**	**Standard Deviation**	**Standardized Factor Loading**	**Composite Reliability**
Perceived tutor support				0.80
My tutor appreciates any extra effort from me	5.49	1.17	0.71	
My tutor would ignore any complaint from me (R)	5.94	1.03	0.64	
Even if I did the best job possible, my tutor would fail to notice (R)	6.04	1.10	0.81	
My tutor shows a lot of concern for me	5.51	1.25	0.67	
Perceived peer support				0.80
The students in my group appreciate any extra effort from me	5.36	1.14	0.66	
The students in my group would ignore any complaint from me (R)	5.72	1.04	0.71	
The students in my group show a lot of concern for me	5.43	1.14	0.71	
Even if I did the best job possible, the students in my group would fail to notice (R)	5.79	1.06	0.77	
Self-consciousness				0.70
I worry how others perceive me in my group	2.60	1.41	0.69	
I am afraid my failings will be noticed by others in my group	2.51	1.35	0.71	
I don't worry about being judged by others in my group (R)	2.91	1.52	0.59	
Psychological safety				0.74
I'm not afraid to express my opinions in my group	5.24	1.11	0.51	
I am afraid to express my opinions in my group (R)	5.74	1.21	0.55	
There is a threatening environment in my group (R)	6.02	1.03	0.70	
I feel safe to take a risk in my group	5.80	1.25	0.72	
I feel it is difficult to ask other students in my group for help (R)	6.38	0.93	0.51	
Offline communication frequency with tutor				0.87
My tutor and I frequently communicate face-to-face	4.30	1.39	0.89	
My tutor and I regularly communicate offline, without using <the system>	4.25	1.36	0.92	
I often discuss work with my tutor face-to-face	3.62	1.36	0.67	
Offline communication frequency with peers				0.82
The students in my group and I frequently communicate face-to-face	5.54	1.08	0.85	
I often discuss work with the students in my group face-to-face	5.19	1.37	0.64	
The students in my group and I regularly communicate offline, without using <the system>	5.63	1.08	0.82	
Perceived usefulness				0.90
Using <the system> improves my study performance	4.41	1.48	0.83	
Using <the system> increases my study productivity	4.44	1.42	0.84	
Using <the system> enhances my study effectiveness	4.42	1.37	0.88	
I find <the system> to be useful in my study	4.98	1.41	0.78	

(Continued on next page)

Perceived ease of use				0.86
My interaction with <the system> is clear and understandable	4.61	1.50	0.79	
Interacting with <the system> is clear and understandable	5.00	1.39	0.56	
I find <the system> to be easy to use	4.63	1.70	0.92	
I find it easy to get <the system> to do what I want it to do	4.50	1.64	0.84	
Groupware usage				0.77
Over the past weeks, I have accessed the shared document repository on <the system>	5.54	1.14	0.86	
Over the past weeks, I have contributed to discussions on the discussion forum on <the system>	5.25	1.26	0.72	
Over the past weeks, I have used the group messaging function of <the system>	5.25	1.61	0.57	
(R) indicates reversely coded items, mean scores display means after recoding				

Since the data for this study were collected from a single source, we assessed whether possible common method effects were present. To do so, we followed guidelines by Podsakoff, MacKenzie, Lee, and Podsakoff (2003). They state that if the predictor and criterion measures are obtained from the same source in the same context and implicit theories may bias the raters' responses, then the single-common-method-factor approach should be used. I.e., to demonstrate that the results are not due to method effects, the addition of a method factor (a latent construct) to a measurement model with *n* factors should not significantly improve the fit over the *n*-factor model. Furthermore, the original factor loadings must continue to be significant in the model including the method factor. The results of this analysis show that the model fit significantly decreased: $\chi^2(528)=5912.51$ ($\Delta\chi^2(69)=5106.35$, $p<0.01$). In addition, all factor loadings to the latent variables were still significant.

3.5.2. Justification for aggregation

To estimate and compare individual-level and group-level effects of social support on psychological safety, the antecedents have to be split in an individual score and the group mean. Thereafter, the individual-level component is used as a control for its group-level analogue in a multilevel regression equation with psychological safety as the dependent variable. If the group-level coefficient remains significant after adding the individual-level effect to the regression equation, this coefficient explains incremental, unique variance in psychological safety that cannot be captured by the individual-level coefficient (De Jong et al., 2005).

In order to empirically justify data aggregation to the team level for the social support constructs using the group means, we calculated the $r_{WG(j)}$ statistic and intra-

class correlation (ICC) coefficients for perceived tutor support and perceived peer support. The $r_{WG(j)}$ coefficient is an indicator of homogeneity of individual ratings within teams. It provided high median values for both variables ($r_{WG(j)}$= .91 for both perceived tutor support and perceived peer support). These findings indicate that individual ratings within groups had a high degree of consistency (James, Demaree, and Wolf, 1993). As an additional measure, the ICC coefficient comprises a ratio of between-groups variance to total variance. The ICC values corrected for measurement error were significant for both perceived tutor support and perceived peer support (F-values $p<.05$). This indicates that each variable possessed a significant amount of between-group variance. Accounting for group size, and therefore more precisely assessing the impact of interdependence, ICC(2) measures were respectively .50 (for perceived tutor support) and .60 for (perceived peer support) yielding evidence for reliable group means (Bliese, 2000).

3.5.3. Multi-level analysis results

The findings of the multi-level analysis are presented in Table 3.2. Model 1 is the base model, while Model 2 includes the hypothesized interaction effects. Both models show a higher R^2 at the group level than at the individual level, indicating that between-groups variation of psychological safety can be better explained by the antecedents than within-group variation. Including the interaction effects, Model 2 shows a significantly better fit than Model 1 ($\chi^2(3)=128.89$, $p<.01$) and also has substantially more explanatory power than its predecessor. It reveals positive individual-level effects of tutor and peer support, providing support for H1 and H2 respectively. At the group-level of analysis, we found a positive effect of tutor support only, thereby supporting H3a. No support was found for H3b since the group-level effect of peer support was nonsignificant.

In testing H1-H4 we controlled for the effects of team size on psychological safety. We did so since Edmondson (2004) suggests that levels of psychological safety can differ with team size, and urges future research to investigate this issue. Our results show that team size as well as its square significantly relate to psychological safety, indicating a negative exponential relationship. Therefore, larger teams of students score much lower on psychological safety. Probably, these teams are more likely to have interpersonal conflicts because with a larger number of people, the chances of conflicting characters are higher. Also, in larger teams, members could be more inclined to free ride at the expense of others as they think it will go unnoticed. Such

behavior lowers the overall engagement to a reach common goal, obstructs a strong team identity, and is therefore detrimental to general feelings of comfort and safety in the team.

Regarding the interaction effects with the individual trait self-consciousness, we found a significant positive interaction effect involving peer support, supporting H4b. Furthermore, the interaction term involving tutor support was nonsignificant, H4a is therefore rejected.

Table 3.2. Multi-level analyses antecedent-psychological safety relationship

	Model 1 Coeff. (s.e.)[a,b]	Model 2 Coeff. (s.e.)[a,b]	Model 2 Standardized Coeff.	Hyp.
Intercept	4.342 (.533)	4.323 (.448)		
Individual-level variables:				
Perceived tutor support	.206 (.056)**	.136 (.045)**	.163	**H1**
Perceived peer support	.186 (.054)**	.098 (.048)*	.115	**H2**
Self-consciousness		-.334 (.028)**	-.493	
Group-level variables:				
Team size	-.069 (.021)**	-.041 (.017)**	-.120	
(Team size)^2	-.021 (.006)**	-.019 (.005)**	-.196	
Perceived tutor support	.224 (.133)*	.206 (.111)*	.100	**H3a**
Perceived peer support	-.155 (.129)	-.089 (.109)	-.046	**H3b**
Interactions:				
Self-consciousness × Perceived tutor support		-.003 (.088)	-.002	**H4a**
Self-consciousness × Perceived peer support		.210 (.089)**	.117	**H4b**
Increase in model fit[c]:		χ^2 (3) = 128.89**		
Explained variance (%)				
Individual-level	22.4	45.7		
Group-level	51.7	66.2		

*$p < .05$; **$p < .01$.
Notes: $N_{teams} = 36$, $N_{individuals} = 361$, significance is based on one-tailed tests.
[a] *Unstandardized regression coefficients.*
[b] *Standard errors between parentheses.*
[c] *The increase in model fit relative to Model 1.*

3.5.4. Structural model of consequences

To verify the second part of our research model, involving the consequences of psychological safety and their interconnections, we included all hypothesized relationships in a structural equation model (SEM) and used AMOS 5.0 (Arbuckle, 2003) for estimations. We estimate this part of the research model using the robust

maximum-likelihood estimator. The model showed good fit with $\chi^2(99)=213.71$; TLI=0.95; CFI=0.96; RMSEA=0.06; SRMR=0.06. All statistics adhered to commonly accepted Hu and Bentler's (1999) guidelines. Table 3.3 gives an overview of the hypotheses testing.

Table 3.3. Results of SEM analysis psychological safety outcomes

Hypothesis	Path coefficient
H5: PS => PU	0.11*
H6: PS => PEOU	0.13*
H7a: OCFT moderates PS => PU	Non-significant
H7b: OCFT moderates PS => PEOU	Non-significant
H8a: OCFP moderates PS => PU	Non-significant
H8b: OCFP moderates PS => PEOU	Significant
H9: PU => GU	0.44**
H10: PEOU => GU	0.33**
H11: PEOU => PU	0.51**
Model fit	$\chi^2(99)=213.71$ TLI=0.95 CFI=0.96 RMSEA=0.06
***p < .01, *p < .05*	
PS = Psychological Safety, OCFT = Offline Communication Frequency with Tutor, OCFP = Offline Communication Frequency with Peers, PU = Perceived Usefulness, PEOU = Perceived Ease of Use, GU = Groupware Usage	

Regarding the path coefficients and corresponding significance values, all relationships in the model were significant at the p<.05 level, thus yielding support for H5, H6, H9, H10, and H11. In addition, we specified offline communication frequency as a moderator in several of these relationships. As a procedure to calculate effects, the sample was first split in high and low groups. This identified individuals which were high in their communication frequency with their tutor and peers respectively, and those which were low in their frequency of communication. We did so using a third split, taking only students of the lowest scoring third part (i.e. 33.3%) and highest scoring third part of the sample regarding offline communication frequency into consideration. This practice is commonly accepted in behavioral and personality research, besides the more traditional and conservative median split, since respondents end-pile their ratings (Dabholkar and Bagozzi, 2002; McCarty and Shrum, 2000). We found that offline communication frequency with

peers positively moderates the impact of psychological safety on perceived ease of use ($\Delta\chi^2(1)=6.4$). Here, for the low group (n=86) the coefficient of the relationship was -0.03 and nonsignificant, while the high group (n=149) displayed a coefficient of 0.32 which is significant at the $p<0.01$ level.

In addition, we tested for a direct effect of psychological safety on groupware usage. Our reason to do so was threefold. First, psychological safety appears to be a key construct in other studies on technology adoption (Edmondson et al., 2001; Edmondson, 2004). Second, the general principle that external variables can only influence technology perceptions or their relative weights (Davis et al., 1989) has been falsified by numerous studies finding direct effects of individual traits, or technology/institutional characteristics, on usage behavior. For instance, Gefen et al. (2003) show consumer trust in an e-vendor to directly relate to intention to use online shopping, and Pavlou (2003) shows perceived risk to be a direct negative determinant of consumer acceptance of e-commerce. Third, by testing the existence of a direct path in our structural model allows us to make statements whether perceived usefulness and perceived ease of use fully or partially mediate the mentioned relationship between psychological safety and groupware usage.

The additional path was found significant ($\beta=0.12$, $p<.05$) and the resulting model did also display an improved fit ($\Delta\chi^2/df=4.9$, $p=.027$). Furthermore, the effects of psychological safety on the two technology perceptions as well as the effect of these perceptions on groupware usage remained significant. This gives evidence for a partially mediated chain of relations. Further evidence was obtained by performing a Sobel mediation test (Sobel, 1982). This test showed non-significant Z values for the mediation of perceived usefulness ($Z=1.429$, $p=.153$) and for the mediation of perceived ease of use ($Z=1.444$, $p=.149$).

Additionally, we tested whether offline communication frequency with tutor and peers showed any significant interaction effects with psychological safety in influencing groupware usage. We find a significant moderation effect of offline communication frequency with tutor strengthening the positive impact of psychological safety on groupware usage ($\Delta\chi^2(1)=6.4$). For students with low frequencies (n=115) the standardized coefficient of the relationship is -0.03 and nonsignificant, while the high frequency group (n=136) shows a coefficient of 0.29 and significance at $p<.01$ level.

3.6. Discussion and conclusion

The key objective of this study is to demonstrate that psychological safety plays an important role in successful educational groupware implementation. Until now, this relatively new construct has mainly shown its usefulness in medical settings, but given the characteristics of our educational setting, we expected positive outcomes of psychological safety here as well. To begin with, we calculated a multi-level model of psychological safety antecedents. Second, we formulated a structural equation model to assess the outcomes of psychological safety. Both models were tested in the context of a groupware system specifically designed for a course on management of organizations by university students.

First, we find that psychological safety has a significant impact on perceived usefulness and perceived ease of use of groupware. Moreover, psychological safety also has a *direct* effect on groupware usage. Apparently, students who feel more safe and comfortable in their environment have less anxiety to use groupware. They show more positive overall attitudes towards the system, and are therefore also more inclined to use it. Our study provides empirical evidence on the importance of a psychologically safe environment as a facilitator of groupware implementation. We therefore add to literature on psychological safety, which mainly pinpoints the role of safety feelings in team and individual work outcomes (Baer and Frese, 2003; Brown and Leigh, 1996; Edmondson, 1999).

Additionally, we find that both tutor support and peer support influence feelings of psychological safety at the individual level. This finding extends existing research as it *empirically* substantiates the notion that supportive processes are important antecedents of psychological safety (Edmondson et al., 2001; Edmondson, 2004). Students who feel that tutor and peers value their contribution and care about their well-being, perceive their study environment to be safer. Moreover, we find a group-level effect of tutor support on psychological safety. Apparently, not only individual study-related perceptions, but also shared perceptions among students about the level of support of the tutor in their group are an important determinant of psychological safety. Team members perceive that their tutor treats them as a group, rather than a collection of individuals. This triggers a synergetic "we are in it together" mentality, which has been shown to be important in enhancing team innovativeness, adaptability, and learning (Edmondson, 1999; Tjosvold, Yu, and Hui, 2004; West and Anderson, 1996). Since members share their beliefs on the level of

tutor support, nobody feels socially isolated, and group cohesiveness is higher. From an organizational behavior perspective, since tutors are agents of the educational institution, having responsibility for directing and evaluating students' performance, students view their tutor's favorable or unfavorable orientation toward them as indicative of the institution's teaching capabilities (cf. Eisenberger et al., 1986). A positive social environment in the classroom and in the institution is related to student's motivation, engagement, and achievements. For instance, they are more motivated to develop competence (Patrick, Ryan, and Kaplan, 2007) and accordingly have more questions and are less inhibited to ask them (Karabenick and Sharma, 1994). These effects can also be achieved by peer support (supported by our individual-level findings) and for younger students even by parental support (Wentzel, 1998).

Further exploring the effects of shared perceptions, we did not find a significant group-level effect of peer support on psychological safety. This result could potentially be due to our research setting. Interpersonal assistance is specifically needed in stressful, high-performance situations where every individual strives for the overarching team goal. If team members have a strongly synergetic view on the supportiveness of peer relationships, this diminishes task and interpersonal ambiguity (Stamper and Johlke, 2003). While the group process was crucial in achieving a good grade, with participation yielding bonus points and the option of helping each other with individual exercises, there was no stress or ambiguity involved in reaching a common goal. Hence, synergy in beliefs on peer support were less important in the determination of levels of psychological safety.

In addition, we find a significant moderation effect of self-consciousness between group-level perceived peer support and psychological safety. This nuances findings in experimental psychology, where the theory of reflexive consciousness predicts that an increased level of self-consciousness will lessen the influence of primes, or stimuli, inconsistent with personal standards (Hull et al., 2002). According to this theory, individuals who are highly sensitive to their social environment and other team members' judgments would prefer to do their work individually. Thus, shared opinions would have less influence on their level of psychological safety. Our results however indicate that if students worry about how they are perceived and judged by other group members, they adhere *more* to shared perceptions which significantly *strengthens* the positive relationship between peer support and psychological safety. Next, we did not find self-consciousness to moderate the relationship between

perceived tutor support and psychological safety. It seems that individuals differing in self-consciousness equally engage in shared perceptions of tutor support. This could be explained by the fact that all tutors were encouraged to stimulate open discussions, invite input, and support interaction.

Finally, our results highlight the importance of a decent level of offline communication in groupware adoption. This corroborates findings in groupware literature that offline contact should supplement online contact via groupware (Benbunan-Fich et al., 2002; Dennis, Wixom, and Vandenberg, 2001; Kelly and Jones, 2001). We find a differential effect of offline communication frequency with one's tutor versus offline communication frequency with one's peers. To begin with, a student's offline communication frequency with his tutor positively moderates the relationship between psychological safety and groupware usage, such that this positive relationship is strengthened. In contrast, an individual's offline communication frequency with his peers positively moderates the relationship between psychological safety and perceived ease of use, again strengthening the existing positive relationship. This difference might be attributed to the fact that the tutor appears to be more relevant when it comes to directly encouraging the use of a technology in everyday work processes and tasks, compared to colleagues (Schillewaert et al., 2005). Particularly in mandatory adoption settings, a tutor, manager, or supervisor has the initial commitment to successfully implement the technology. Frequently it is his task to get people involved with the system. Therefore, if students or employees get well-funded and convincing feedback by a committed superordinate, this stimulates their groupware usage. On the other hand, individuals on the same hierarchical level are well suited for helping each other out with *problems* they experience in working with the technology. An abundance of research states that peer support and codiscovery learning are effective mechanisms to acquaint people with a technology (Gallivan, Spitler, and Koufaris, 2005, pp. 159-160). Therefore, if individuals feel safe and speak with their peers, the amount of offline communication positively influences their perceptions of system usability. However, the *commitment* of peers towards using the system is lower, possibly explaining the differential moderating effect. In sum, it seems that both a decent level of offline communication with one's tutor as well as with one's peers is necessary to reap the potential benefits of psychological safety in technology implementation and adoption.

From a more practical perspective, our research results imply that tutors should create a psychologically safe, non-threatening work environment for their subordinates, as a way to enhance groupware adoption. A safe environment triggers more positive attitudes towards the groupware technology and makes students more inclined to use the system. As strategies for enhancing the level of psychological safety, previous literature has emphasized building interpersonal relationships based on trust and using practice fields, such as groupware prototypes (Edmondson, 2004). This study gives tutors more detailed directions by relating social support to psychological safety.

Additionally, tutors should ascertain that students treat each other with respect and dignity and value each others' input in order to stimulate a non-threatening environment. They can do so by setting a good example themselves. Especially changing students' attitudes can be difficult since it might entail changing interpersonal and "organizational" culture values, something which is notoriously hard to do (Ostroff, Kinicky, and Tamkins, 2003; Schein, 2004). We therefore suggest the development of interpersonal relationships where tutors are supportive, and not controlling, in their interactions with students (Brown and Leigh, 1996; Edmondson, 1999). This allows students to try and experiment. Additionally, tutors should give students freedom of choice and control over their work instead of being rigid, inflexible and controlling with regard to used work methods.

Furthermore, our findings indicate that *shared perceptions* of a team regarding tutor support also significantly contribute to individual safety perceptions. Therefore, in creating consensus among students about the supportive strategy in their group, tutors should focus their attention on the group as a whole rather than individually monitoring its members. We advocate refraining from personal politics, preferring the interest of particular people (including the self) above that of others. Moreover, team procedural justice should be stimulated. This is the fairness of the decisions to determine the distribution of resources among team members (Greenberg, 1990). The key ingredient is to treat students with dignity and respect, and openly provide information how organizational policy outcomes (e.g. course grades) are determined. Finally, offering collective training and practice sessions with the groupware will both enhance support perceptions (Rhoades and Eisenberger, 2002) as well as psychological safety directly (Edmondson, 2004).

For some individuals, supportive relationships within a team are more beneficial than for others. Students who are afraid of being judged and criticized by others and therefore have a high level of self-consciousness, adhere more to shared perceptions of peer support. Therefore, for individuals of this nature, this type of support is essential in enhancing psychological safety. Tutors should therefore carefully consider each student's personality and assure that the general level of peer support in a group where members with high self-consciousness reside is of a decent standard.

Finally, an important finding of our research is that the offline communication frequency with one's tutor and peers can considerably strengthen the positive effects of psychological safety. Tutors should therefore optimize both the tutor-student as well as the student-student communication flows in order to reap the full benefits of a psychologically safe environment. One possibility is arranging joint (social) activities to foster team building and strengthen the shared values.

3.7. Implications for future research and limitations

Our study opens several opportunities for future research. First, the empirical results show the importance of social processes and support in technology adoption. Future studies should further explore the role of socially constructed variables in a psychological safety framework. However, while these predictor variables reflect important interpersonally oriented behaviors, future studies could also add conceptual richness by considering the impact of technical-administrative or task-related procedures and behaviors. Constructs like role clarity (Brown and Leigh, 1996) and empowerment (Valadares, 2004) deserve attention in this respect, especially when the setting is a business environment.

Second, and additionally, our study enhances our understanding of the impact of antecedent-psychological safety relationships *across levels of analysis* and thereby demonstrates the multi-level nature of psychological safety and its determinants. Although recent team-related research streams increasingly recognize the importance of comparing relationships across levels (Ostroff, Kinicky, and Clark, 2002), conceptual notions have been rarely discussed in groupware research. Therefore, future research should investigate whether variance in support perceptions among team members is also a relevant issue in (non-)educational teams differing in *tasks* and *member characteristics*.

Concerning different *tasks*, while Edmondson et al. (2001) find psychological safety to be important in cardiac surgery teams using a new surgery technology, this study extends this conclusion to an educational context. We find effects despite the fact that procedures and teamplay around a surgery table differ widely from the practices in our setting. Future research might consequently elaborate on relationships and effect sizes in still other contexts where people's interdependency is higher or outcomes are more uncertain. May et al. (2004) state for instance that relationships involving psychological safety may be stronger for more complex, uncertain, creative tasks than for those that are relatively simple and well defined.

Concerning *member characteristics*, our study is based on a sample of university students. Therefore, our findings should be interpreted with care when trying to generalize them beyond the educational context. Future research should therefore ideally use real business-related data to further explore the concept of psychological safety. Additionally, we used a cross-sectional research design where measurement took place at a fixed point in time. While groupware usage is expected to be a relatively stable phenomenon, the distribution of the questionnaire after seven weeks of experience with the system remains an arbitrary time period. Longitudinal research can produce even more insightful results.

Further elaborating on measurement issues, future research should aim to assess information from different sources. While we statistically concluded that common method effects do not bias our analysis by applying a single-common-method-factor approach, non-response bias is another commonly suggested survey-related problem that could still occur. In our study, it was not possible to apply the procedure suggested by Armstrong and Overton (1977). They suggest comparing characteristics and answers of early responders with late responders to the survey, as the latter would resemble non-respondents. However, all of the respondents finished the survey within a time slot of 15 minutes (i.e. the break of the second-to-last tutorial meeting), making such a comparison not viable.

Finally, while we find an important moderating role of offline communication frequency, surprisingly little is known about the role of interpersonal communication in the field of technology adoption. While subjective norm has been studied relatively often (cf. Venkatesh et al., 2003), our findings illustrate that there is more to the equation then just social pressure to adopt. Future research could focus on communication characteristics, including communication mode (used channel,

channel media richness), communication direction (unidirectional, bidirectional), or more objective measurements of communication frequency (preferred number of messages or meetings).

Chapter 4

Antecedents and consequences of GDSS potency in boundary-spanning service teams: A multi-level assessment[3]

In this paper we examine the central role of Group Decision Support System (GDSS) potency beliefs in enhancing the role-prescribed performance and extra-role service innovation support of boundary-spanning service teams. GDSS potency is the shared perception that team members have of their joint ability to effectively take decisions across a wide range of service tasks using GDSS technology. A conceptual model of antecedents and consequences of GDSS potency is developed and tested. As the service teams operate in a multi-team environment, we investigate how consensus on cooperation within as well as between teams moderates the impact of antecedents. Data were collected from 198 service employees, organized in 28 teams. The results of hierarchical linear modeling reveal positive individual-level effects of peer usage and customer influence on GDSS potency perceptions. Furthermore, competitive pressure and customer influence impact GDSS potency at the group-level of analysis. Consensus on the level of cooperation within a team strengthens the group-level influence of competitive pressure, while between-team consensus on the importance of cooperation strengthens the impact that customer influence has on GDSS potency. At the same time, between-team cooperation decreases the impact of supervisor influence. Finally, individual perceptions of GDSS potency positively relate to role-prescribed service performance and service innovation support by individual members of the team. In contrast it was found that GDSS effectiveness is enhanced by team-level perceptions on GDSS potency.

[3] Next to Jeroen Schepers, Ad de Jong, Ko de Ruyter, and Martin Wetzels contributed to this research project.

4.1. Introduction

Boundary-spanning service teams are increasingly supported by technology to facilitate and enhance decision-making in the service delivery process (Griffith, Sawyer, and Neale, 2003). For example, teams of technicians who provide on-site support are increasingly supported by Group Decision Support Systems (GDSS). This is a technology that combines computer, communication, and decision technologies to support group decision-making (Limayem, Banerjee, and Ma, 2006). In addition, GDSS is also used to support individual cognition in a group setting; i.e. GDSS better structures information from all team members in order to facilitate higher *individual* decision quality (Hilmer and Dennis, 2001). The availability of GDSS has enabled and accelerated the virtualization of service delivery teams, such that team members can be geographically dispersed, and therefore close to customers, markets and resources in their local contexts. This is important, as service teams are increasingly expected to not only perform role-prescribed service tasks, but also collaborate closely with customers to assess and improve service delivery systems, develop operational efficiency, and identify new business opportunities. Contingent upon the heterogeneity of customer needs and consistent with the notion of customers as co-producers, this type of service innovation is clearly distinct from more formalized, R&D-based new service development that commonly occurs at the company or project level (Flikkema, Jansen, and Van der Sluis, 2007). Team-based service innovations can be considered as a collaborative social endeavor that emerges from team cooperation within the firm as well as with customers (cf. Baptista, 1996).

A recent Cisco study noted that teams supported by GDSS spend on average only 13% of their time in face-to-face meetings (eLearning Forum Meeting, 2003). It has also been argued that technology-based decision-making typically involves higher levels of uncertainty and ambiguity (Griffith and Neale, 2001). Moreover, as decision-making becomes more virtual, intra-team conflict appears to occur more often (Hinds and Mortensen, 2005). While traditional approaches have focused on these consequences of technology innovations by service firms (Coombs and Miles, 2000), more recent approaches examine how user cognitions determine and transform the impact of technology as a service innovation enabler (Gago and Rubalcaba, 2006). Consistent with this view, we argue that in order to overcome the barriers to decision-making effectiveness, team members need to stronger rely on social cognitive processes, such as the confidence in the team's ability to deal with this new mode of decision-making (Jarvenpaa, Knoll, and Leidner, 1998; Kelly and Jones,

2001). Recent studies have identified group potency, or "team-member confidence in their collective ability to perform" (De Jong, De Ruyter, and Wetzels, 2005, p. 1610), as a powerful predictor of team effectiveness (Lee, Tinsley, and Bobko, 2002; Pearce, Gallagher, and Ensley, 2002). In this paper, therefore, we introduce the concept of GDSS potency, and examine its antecedents and consequences. Specifically, we attempt to make the following substantive and empirical contributions.

First, Bandura (1997) has identified four sources of collective confidence beliefs: (1) mastery experience, (2) physiological states, (3) vicarious experience, and (4) verbal persuasion. The first two sources reflect individual experiences, while the latter two are socially constructed influences. Thus far, however, the impact of these sources has been left unexplored in relation to the team's ability to effectively use GDSS. Recent theorizing on virtual teams has indicated that particularly social influences are important determinants of collective motivations, confidence, and outcomes (Maruping and Agarwal, 2004; Ocker, 2005). Therefore, we examine multiple manifestations of vicarious experience and verbal persuasion as predictors of GDSS potency beliefs in boundary-spanning service teams.

Second, it has been argued in recent team research that effectiveness should be assessed in relation to structural contingencies of the environment in which the team operates (Stewart and Barrick, 2000). Teams do not function in isolation, but are part of multi-team systems in which interdependencies and collective goals exist (Mathieu, Marks, and Zaccaro, 2001; DeChurch and Marks, 2006). Lievens and Moenaert (2000) demonstrate that cooperation between teams positively moderates the effectiveness of social communication processes in reducing uncertainty. So far, the moderating impact of cooperation has not been explored in relation to team decision-making. This motivates us to investigate the moderating impact of cooperation on antecedent-GDSS potency relationships.

Third, each team possesses its own typical set of shared perceptions of social processes, leading to variance in perceptions of GDSS potency (cf. Mathieu, Heffner, Goodwin, Salas, and Cannon-Bowers, 2000). Therefore, we examine whether group-level aggregated antecedents explain incremental variance in GDSS potency, compared to their individual-level analogues. Additionally, in order to use information as input for effective decision-making, *consensus* among team members on the level of cooperation within the team is an essential precondition (Hopthrow and Hulbert, 2005). We therefore model the moderator of antecedent-GDSS potency

relationships (i.e. cooperation) as a consensus construct. A multi-team organizational system implies that these interactions can occur among team members within a team as well between teams (Coen, 2006; Lindell and Brandt, 2000; Zohar and Luria, 2005). Consequently, we model cooperation as within-team cooperation consensus and between-teams cooperation consensus.

Finally, despite the observation that customer contact employees can be major contributors of blockbuster new ideas, their role in new service development stands largely underinvestigated (Jayasimha, Nargundkar, and Murugaiah, 2007). In addition to role-prescribed behaviors, service employees are expected to provide support to customers in service innovations and leverage their assets as extra-role activities (De Jong and De Ruyter, 2004; Rothenberg 2007). It has been argued that many service innovations initiated by boundary-spanning employees are not necessarily driven by economic motives, but by pro-social behavior or helpfulness (Flikkema et al., 2007). Jayasimha, Nargundkar, and Murugaiah (2007) and Oke (2007) argue that service innovations need to be developed in interaction with customers, as the interaction is an integral part of service delivery. We therefore posit GDSS potency beliefs to be a determinant of team members' role-prescribed service performance and service innovation support. We contribute to the literature by responding to the growing need to understand the processes that intervene between process (technology) and outcome types of service innovation (Limayem et al., 2006).

4.2. Theoretical background and hypotheses

4.2.1. GDSS potency

Team efficacy, or collective efficacy, is a team's belief that it can successfully perform a specific task or course of action (Gully, Joshi, Incalcaterra, and Beaubien, 2002). The concept has its roots in social cognitive theory (Bandura, 1986). It is more than the sum of the members' beliefs in their own capabilities to perform a certain task, as members must coordinate their actions and are influenced by their coworkers (Bandura, 1997). Where team efficacy refers to collective confidence beliefs on a specific *task*, Shea and Guzzo (1987a) propose group potency to reflect more *generalized* employee beliefs about the team's performance capabilities *across* tasks and contexts. Hence, group potency is the collective belief of a team that it can be effective, no matter what the task (Kirkman, Rosen, Tesluk, and Gibson, 2004). As a

GDSS supports decision-making across a variety of tasks, a focus on potency beliefs seems conceptually appropriate.

Collective confidence beliefs build through a process of team collaboration, where members are influenced by the motivation and performance of their colleagues (Gully et al., 2002). In service teams, information conveyed by electronic means such as a GDSS carries fewer cues compared to face-to-face interactions, as it does not include aspects like body language, voice tone, and facial expressions. Furthermore, instant feedback from colleagues is often absent. GDSS consequently changes information flows and the way people work (Rebstock Williams and Wilson, 1997), leading to more ambiguity in the coordination of work processes and outcomes. Given the added complexity from using technology in these teams, Fuller, Hardin, and Davison (2007) propose that collective confidence perceptions should carry a context-specific referent. They introduce the construct of virtual team efficacy or "the virtual team's belief in its ability to work together successfully in a non-collocated, technology-mediated environment" (p. 212) as an important determinant of distributed teams' performance. However, their study leaves two important research questions unanswered. First, as acknowledged by the authors, an important limitation is that the sample consists of student teams. This raises the question whether similar effects can be observed in organizational settings. Second, from a theoretical point of view, GDSS typically involves a rather generic tool that can support a *wide range* of service tasks, independent of the service context in which it is applied. One could question whether team efficacy is the correct theoretical basis for further context-specification. In contrast, we propose a broad conceptualization, defining GDSS potency as the shared perception of team members that their team has the ability to use the GDSS to support decision-making across a wide range of service tasks.

4.2.2. Drivers of GDSS potency

We define two types of social influences which are prominent determinants of confidence beliefs: (1) vicarious experience and (2) verbal persuasion. *Vicarious experience* lets individuals make judgments on their own capabilities when they observe others performing a task. It has not received much attention as a driver of collective confidence beliefs. Only Prussia and Kinicky (1996) demonstrate that vicarious experience can act as a determinant of collective efficacy. In relation to

services teams we identify internal and external sources of vicarious experience; (1) *peer usage* and (2) *competitive pressure*.

First, members of boundary-spanning service teams can observe *colleagues* consulting the GDSS as a knowledge base during an occasional face-to-face meeting. If these peers have a positive attitude towards the GDSS and communicate its effectiveness to the other team members, network externalities and effects of critical mass emerge. Skeptic users will be more motivated to believe that their group can be successful using the technology, as a number of peers are already taking a positive stance towards it. Additionally, having technology "pioneers" in the team enables training-on-the-job. This can be a powerful facilitator of self-efficacy (Brown, 2003) and shape positive attitudes towards information technology (Gallivan, Spitler, and Koufaris, 2005; Venkatesh, 1999). This sparks a shared confidence that the group can work effectively using the GDSS. An additional motivating effect can be observed when communication flows between team members are technology-mediated. Employees using the GDSS only sparsely, will notice that more heavy users have contributed to discussions or documents, and this can build confidence in the team as a whole. We therefore expect that a positive internal vicarious experience, or peer usage, will enhance the GDSS potency of a team. Hence, we posit that:

- *H1. Peer usage positively influences a team's GDSS potency.*

Second, competitors might be using comparable technologies. Robertson and Gatignon (1986) discuss the competitive behavior paradigm which contends that a competitive environment positively influences technology adoption and evaluations. Higher competitive intensity spurs change incentives, and adopting innovations builds both cost advantages and barriers to entry for (potential) competitors. This proposition has thereafter been verified in different types of industries (Majumdar and Venkataraman, 1993; Premkumar, Ramamurthy, and Crum, 1997). In addition to the underlying economic factors, observing competitors using a comparable technology can have an impact on cognitions. For instance, vicariously learning from other organizations' experiences is an important way in which organizations acquire knowledge (Kim and Miner, 2007). Observing rivals achieve compelling results using technology in their business processes builds the collective belief that this technology can improve decision processes and enable the accomplishment of team goals. Therefore, we expect that an external vicarious experience, or competitive pressure, will enhance the GDSS potency of a team. We hypothesize:

- *H2. Competitive pressure positively influences a team's GDSS potency.*

With verbal persuasion, people are led to believe through suggestion from another source (e.g. a colleague) that they are able to cope successfully with a situation that has previously been overwhelming (Strauser, 1995). In contrast to vicarious experience, *verbal persuasion* has a longer tradition in empirical studies on confidence beliefs. Previous operationalizations of verbal persuasion have indicated its potential to influence individual's attitudes and behaviors. For instance, the Pygmalion effect reflects an increase in employees' performance that results from managers raising their expectations about subordinates (Dvir, Eden, and Banjo, 1995; Eden and Kinnar, 1991). As another example, subjective norm involves "a person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen, 1975). This type of normative pressure is often applied in technology adoption studies and can influence usefulness perceptions as well as people's intention to use a new technology (Schepers and Wetzels, 2007).

Besides influencing individual's attitudes and behaviors, prior theory and research indicate that persuasive communication from influential individuals is an important antecedent for building collective confidence perceptions (Gully et al., 2002; Guzzo, Yost, Campbell, and Shea, 1993; Howell and Shea, 2006). In a service team, these information sources are important social cues to overcome uncertainty and ambiguity in the absence of physical communication cues. Analogous to vicarious experience, we identify two sources of verbal persuasion: internal to the team and external to the team. We refer to internal verbal persuasion as *supervisor influence* and to external verbal persuasion as *customer influence*.

First, effective coaching by a manager contributes to team members' confidence in the team's ability (Edmondson, 1999). When leaders convey their high expectations of the GDSS's effectiveness in supporting the team's work processes, team members are more likely to complete their assignments because of higher potency perceptions (Kirkman and Rosen, 1999). This aligns with transformational leadership, where a leader who expresses an optimistic and appealing vision can create an awareness of the higher organizational goals to build a collective team identity. Consequently, this strengthens team collective identity and potency (Shamir, House, and Arthur, 1993). This is also the basis of champion behavior on the part of a manager. Communicating a favorable view of the innovation's usefulness for the organization has been shown to influence potency beliefs (Howell et al., 2006). Therefore, we expect that internal

verbal persuasion, or supervisor influence, will enhance the GDSS potency of a team. Hence, we state:

- *H3. Supervisor influence positively influences a team's GDSS potency.*

Second, customer perceptions of the service process are important since successful organizations must deliver services tailored to the customer's preferences. Especially employees working at the outer boundary of an organization are susceptible to these contextual influences (Jelinek, Ahearne, Mathieu, and Schillewaert, 2006). When customer perceptions are positive, they can reciprocate to employee beliefs about their collective competence. For instance, De Jong, De Ruyter, and Wetzels (2006) show that both team efficacy and group potency are reciprocally related to service quality. Especially customer perceptions of the quality delivered have a large influence on employee beliefs about their collective competence. When front-line employees notice that customers are satisfied with the GDSS-supported service, the team members' confidence that they can perform effectively using the technology is likely to increase (cf. Ryan, Schmit, and Johnson, 1996). In such a situation, collective confidence mirrors customer satisfaction, giving rise to a causal loop between customer attitudes and positive work climates (Schneider, Hanges, Smith, and Salvaggio, 2003). Furthermore, customer pressure to use innovative technologies can create a positive organizational awareness of the benefits of this technology (Cata, 2003) as well as a enhanced individual intention to adopt (Jelinek et al., 2006). Hence, we expect that external verbal persuasion, or customer influence, will enhance the GDSS potency of a team. We therefore hypothesize:

- *H4. Customer influence positively influences a team's GDSS potency.*

4.2.3. Group-level effects

Employees working in teams, no matter whether they are virtual, develop shared perceptions of their work environment (Kozlowski and Klein, 2000). This process of convergence in perceptions is driven by social dynamics among group members. The shared beliefs of the virtual team members can help them to develop shared knowledge and norms. Furthermore, it enables joint decision-making. Researchers have therefore proposed that individual team-member perceptions can meaningfully be aggregated to a team level of analysis (Mathieu et al., 2000; Chen and Bliese, 2002). These aggregate-level constructs represent psychosocial aspects that are not captured

by individual-level measurement, but they may have a differential impact on perceptions of GDSS potency. The significance of such group-level constructs refers to the occurrence of synergetic, social processes among individuals within teams.

When team members communicate online, give digital feedback, work on documents in the virtual repository, or meet each other face-to-face, they integrate their opinions, constituting a shared perception of the social influences in their work environment (cf. Mathieu et al., 2000). As such, they construct joint opinions on how sources of vicarious experience and verbal persuasion influence their perceptions of GDSS potency. Therefore, to capture the social influences on GDSS potency that go beyond individual team members' perceptions, we adopt an approach that analyzes the influence of predictor variables at two levels.

Following the majority of studies, our group-level operationalization of antecedents is based on the direct consensus model, where the group-level variables reflect aggregates of the individual scores. This entails that the relationship between the antecedents and GDSS potency is primarily hypothesized at the individual level, while hypotheses H5a - H5d are included to examine whether the group level yields additional, differential, effects to the explanation of GDSS potency. Therefore:

- *H5. At the group-level of analysis there is a positive effect of peer usage (H5a), competitive pressure (H5b), supervisor influence (H5c), and customer influence (H5d), that accounts for a significant amount of additional variance in GDSS potency.*

4.2.4. The moderating role of cooperation

Previous studies indicate that the direct effect of team characteristics on team performance processes (e.g. team efficacy, group potency, etc.) lacks consistency across different work settings, indicating the presence of moderator variables such as task characteristics or social support (Stewart et al., 2000). Recent studies have started to focus on the moderating impact of interpersonal processes within teams (e.g. Hui, Chiu, Yu, Cheng, and Tse, 2007; Lievens and Moenaert, 2000; Schneider, Salvaggio, and Subirats, 2002). An important issue is how to appropriately conceptualize and operationalize constructs reflecting these social processes. Recent scholars have proposed that group-level interactions and processes that occur within teams should be composed in terms of the consensus on team member beliefs (Kirkman et al., 2001; Schneider et al., 2002). Rather than calculating the *level* or *quality* of a criterion

variable by taking the group average as mode of aggregation, shared beliefs assessed by within-group variance allows to identify the *strength* of contextual factors (Lindell et al., 2000). In order to integrate all available information in an effective team decision, it is important to have consensus to cooperate while addressing complex customer problems (Hopthrow et al., 2005). A consensus operationalization is able to capture a team's collective history of socially constructed norms, decisions, routines, and patterns of interaction (Kirkman et al., 2001). In contrast, aggregation models hide the substantive importance of dispersion in predicting work-related outcomes. For instance, Dineen et al. (2007) show that employees least satisfied with their job were not the most likely to be absent from work, but rather were *less likely* to be absent from work if their teammates held similarly negative evaluations of their external work context. This seemingly counterintuitive pattern compared to individual-level effects indicates the importance of dispersion measures.

Hackman (1992) notes that external contextual and internal structural factors serve as discretionary stimuli that differentially influence individuals' perceptions of team social processes, producing systematic variation in its ratings. In service teams, members work in an organizational team structure, but still tend to be (partly) monitored and rewarded individually. In addition, during their relatively autonomous service delivery, individual team members are influenced by different customer and market stimuli. Consequently, team members' beliefs on their work environment and team processes are shaped in different ways. However, a lack of consensus on the need for cooperation can result in non-use of the GDSS by a group minority, undermining the potentially synergetic effects of this technology.

In a previous study, Lievens and Moenaert (2000) show that the effectiveness of team project communication in reducing innovative uncertainty is contingent on the level of cross-functional cooperation. Being cooperative opens employees to new and potentially opposing information from different sources, which helps to develop a more complete awareness and appreciation of the situation's complexity (Tjosvold, Tang, and West, 2004). Hence, cooperation can be considered as an essential precondition when communicating with others serves as an uncertainty reducing mechanism (Lievens et al., 2000). High consensus on the team's cooperation is indicative of a higher social integration among team members, which will strengthen the positive impact of predictor variables when the formation of GDSS potency would be hampered by interpersonal friction, conflict, and process losses (cf. Lindell et al., 2000). Therefore, we hypothesize that higher perceptual consensus on team

cooperation will enhance the positive impact of the social influences of various sources on GDSS potency:

- *H6. At the group level of analysis, the positive effect of peer usage (H6a), competitive pressure (H6b), supervisor influence (H6c), and customer influence (H6d) on GDSS potency is stronger when within-team cooperation consensus is higher.*

Organizational behavior literature has long suggested that globally aligned, yet locally distinctive climates may arise in organizations (Martin, 1992). Employees develop consensual assessments of the desired role behavior, and act according to these subclimates. Therefore, in addition to within-group consensus, recent multi-level research (Zohar et al., 2005) has advocated to extend the analysis of consensus constructs to the business-unit level by taking into account *between*-groups variability. Having similar performance objectives, boundary-spanning service teams can benefit from each other by sharing customer and market information. Consequently, the effectiveness of front-line service teams depends on the larger organizational system which embodies them (Mathieu, Gilson, and Ruddy, 2006).

Although company policies and procedures set limits on between-teams variation, variability in beliefs on social processes such as team cooperation may still vary extensively between teams. For instance, especially in boundary-spanning teams, group polarization or groupthink may occur due to conformity pressure within the group, market volatility, and/or competition within the organizational environment (Janis, 1982). A higher consensus on intra-team cooperation between the different service teams allows to develop a shared social identity within the business unit. This increases each team's willingness to rely on each other, as interteam friction, conflict, and process losses are less likely to occur. In other words, teams that share beliefs on their internal level of cooperation are more likely to exchange information. This causes team members to be better informed, as a higher level of external information trading is likely to enhance internal information trading as well (Teigland and McLure Wasko, 2003). Hence, opinions and information from internal sources as well as external sources are expected to be more salient in GDSS potency development. We therefore hypothesize:

- *H7. At the group level of analysis, the positive effect of peer usage (H7a), competitive pressure (H7b), supervisor influence (H7c), and customer influence (H7d) on GDSS potency is stronger when between-teams cooperation consensus is higher.*

4.2.5. GDSS potency outcomes

Scholars have related shared confidence perceptions to outcomes such as customer service perceptions (Shea and Guzzo, 1987b) and team profitability (Guzzo et al., 1993). Potency perceptions are also likely to have positive effects on individual employee behavior by offsetting the negative influences of ambiguity and intra-team conflict, to which GDSS-supported teams are especially prone (Kankanhalli et al., 2007; Maruping et al., 2004). If ambiguity and conflict exist, team members may not be able to perform their standard service behaviors that are required in this job (Bettencourt et al., 1997; MacKenzie et al., 1998; Maruping et al., 2004). With GDSS potency indicating the absence of conflict, we expect that service employees will display a better role-prescribed service performance.

In addition to creating boundary conditions for role-prescribed behaviors, collective confidence perceptions can also trigger teams to *experiment* with new procedures and practices (Bunderson and Sutcliffe, 2003; Edmondson, 1999). Higher levels of potency positively influence innovative and creative team performance over time (Howell et al., 2006), and encourage team proactivity (Kirkman et al., 1999; Spreitzer, 1995). This is of particular importance to teams generating and improving new services as it enables innovation (Crant, 2000; Den Hertog, 2000). This type of innovation has also been labeled 'expertise-field innovation', in that it comprises the detection of customer needs and responding to these (Flikkema et al., 2007). Service employees should support their customers in finding a more innovative and effective solution for a service problem, which is to be preferred above a default and habitual course of action. Moreover, at a more global level, companies such as Xerox and HP have equipped their front-line service employees with productivity assessment tools that they can use to propose alternative document processes.

Finally, the belief that one can successfully work with a new technology takes away one's anxiety and stimulates more positive perceptions towards an innovation (Thompson, Compeau, and Higgins, 2006). GDSS potency can lessen the resistance to unfamiliar work and decision processes induced by the GDSS, enabling the group to use the system as the designer intended. This connects to task-technology fit theory, which states that the "fit" between the task at hand and the configuration of the GDSS is the primary driver of effective outcomes (Dennis, Wixom, and Vandenberg, 2001; Zigurs and Buckland, 1998). Hence, we hypothesize:

- *H8. GDSS potency positively influences team members' role-prescribed service performance.*
- *H9. GDSS potency positively influences team members' service innovation support.*
- *H10. GDSS potency positively influences GDSS effectiveness.*

Analogous to hypothesis 5, we expect that as team members work together, encounter similar situations, and solve complex problems, they converge on their beliefs of GDSS potency. These synergetic processes represent psychosocial aspects that are not captured by individual-level measurement. Therefore, to capture the influence of GDSS potency on the outcome measures that goes beyond individual team members' perceptions, we posit that the group-level assessment of GDSS potency yields additional effects to the explanation of individual behavior and GDSS effectiveness. We therefore hypothesize:

- *H11. At the group-level of analysis there is a positive effect of GDSS potency on team members' role-prescribed service performance (H11a), service innovation support (H11b), and GDSS effectiveness (H11c) that accounts for a significant amount of additional variance in these outcome variables.*

The hypotheses above give rise to our conceptual model, depicted in Figure 4.1.

4.3. Methodology and study design

4.3.1. Research setting

We selected an international high-tech company as an empirical setting for testing our conceptual model. The firm offers innovative print and document management products and services for professional environments, operates in 80 countries, and employs 24.000 people. The firm operates in markets that are increasingly characterized by a rapid commoditization of products. Furthermore, it increasingly feels the pressure to shift from selling disposable products to selling a range of innovative services around products that help customers improve their business. The company is undergoing a transition from a hardware manufacturer to a service provider that supports information flows within organizations. As a result of this strategic reorientation, over 50% of the company's revenue is now driven by services.

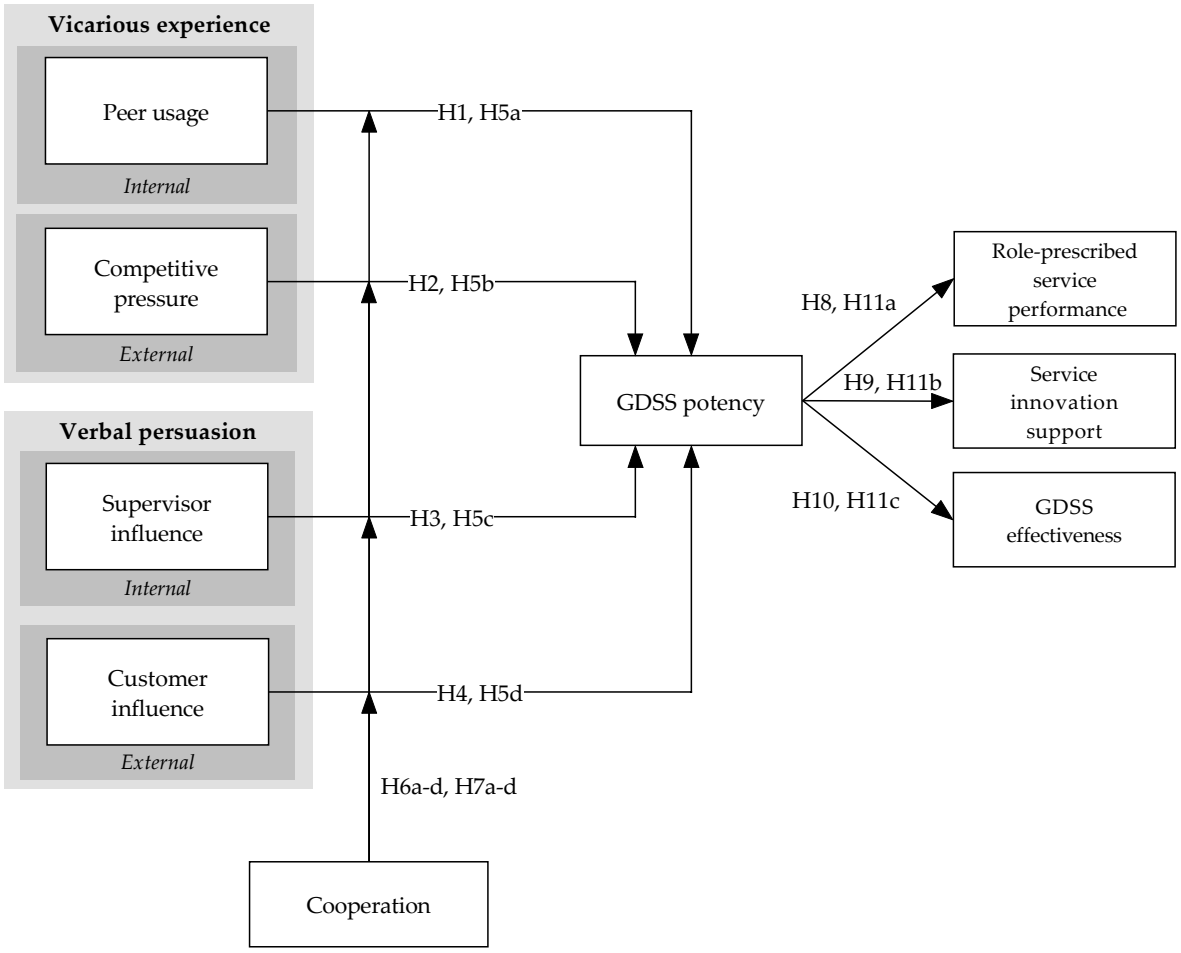


Figure 4.1. Antecedents and consequences of GDSS potency

The company employed teams of service technicians to offer on-site service, including maintenance of installed products and proactively identifying latent customer service demands. Team members mostly worked out of the office, performing their tasks at a client. Face-to-face team meetings were organized once a week. Despite the high involvement of these front-line employees in the clients' work process, knowledge was poorly shared with colleagues. The team did not document solutions to existing customer problems, causing each service technician to re-invent the wheel for similar problems at different clients and make erroneous decisions. In addition, there was no feedback from these front-line employees to the R&D department and vice versa. This gave rise to a poor translation of newly identified customer needs to marketable products and also obstructed customer contact employees' service innovation support as improvements from the lab were not used to offer the most up-to-date service to clients. Besides, the growing number of

product lines offered and the diversity of its technical components called for multiple teams specializing in providing services across different product lines.

To tackle the problems of communication and documentation, as well as the need for multiple teams, the company has recently introduced a multi-team system of boundary-spanning service employees supported by GDSS technology. Each team is responsible to service a specific product line. Team members insert their field experiences (e.g. error codes, user complaints and demands, machine performance data, etc.) into shared knowledge repositories and discussion forums, which allows fellow members to give their feedback, opinions and solutions. As a consequence, a service employee can make better informed decisions. The newest R&D findings are also well-documented, allowing the service employees to offer clients the latest technological innovations. It also provides cost-effective service employees' skill cross-training, reducing the risk that a technician does not have the skills to diagnose and solve a customer problem (cf. Agnihothri and Mishra, 2004). In addition, shared digital agenda's allow face-to-face meetings to be planned on a more flexible basis, saving resources as meetings are only planned when necessary. The GDSS services also let managers effortlessly monitor team members' contributions and progress, simplifying the traditionally complex R&D productivity measurement process (Bremser and Barsky, 2004). As several product lines share a subset of their technical components, members of other teams may also read discussions and contribute by sharing their knowledge. In sum, GDSS has further virtualized existing teams and enabled a structure of autonomously functioning service teams, whose members can share their knowledge within their team as well as with other teams. This benefits service employees, managers, and customers.

4.3.2. Sample characteristics

For the study 327 questionnaires were handed out personally to boundary-spanning service employees. A total of 198 completed questionnaires were returned, yielding a response rate of 60.6%. Of these 198 respondents, 50 respondents were between 21 and 30 years of age, 59 respondents were between 31 and 40 years of age, 57 respondents were between 41 and 50 years of age, and 32 respondents were older than 50 years of age. Furthermore, 50 respondents had been working with the company for less than four years, 48 respondents had five to 12 years of tenure, while 100 respondents had been working at the company for more than 12 years. The 198 respondents were derived from 28 teams. These teams worked on ten different

product lines. The maximum number of teams associated with one specific product line was four, while the minimum number of teams servicing a product line was two.

4.3.3. Measurement

All latent constructs were operationalized by multi-item scales. For all latent constructs, except GDSS effectiveness, participants indicated their (dis)agreement with a set of statements using a seven-point Likert-type scale that ranged from "strongly disagree" (1) to "strongly agree" (7). Peer usage, competitive pressure, supervisor influence, and customer influence were measured by three items each. The item wordings were based on the operationalization put forward by Schillewaert, Ahearne, Frambach, and Moenaert (2005) and adapted to the specific context. GDSS potency was based on five items suggested by Guzzo et al. (1993), where the wordings were tailored to reflect the specific GDSS setting. Role-prescribed service performance and service innovation support were based on scales of in- and extra-role behavior (cf. Bettencourt and Brown, 1997). To measure GDSS effectiveness we adapted a three-item semantic differential scale from Suh (1999). Respondents answered the question "how would you describe the decision-making process you and your team members experience using the GDSS?". The scale-ends included inefficient (1) - efficient (7), confusing (1) - understandable (7), and satisfying (1) - dissatisfying (7). Finally, cooperation was assessed by four items adapted from Tjosvold, Yu, and Hui (2004). To reflect within-team consensus, we used the standard deviation of team member perceptions of their team. Recent research suggests that a standard deviation approach can be preferred to using the $r_{WG(j)}$ statistic as a reflection of consensus (Schneider et al., 2002; Zohar et al., 2005). For instance, the distribution underlying the $r_{WG(j)}$ does not always accurately reflect the response range (Bliese, 2000). The operationalization of between-teams variability is based on Zohar and Luria's (2005) operational definition of climate variability. Specifically, we assess between-teams consensus on team cooperation by taking the standard deviation of group means of team cooperation for each business unit (area of expertise). The exact item wordings can be found in Table 4.1.

Table 4.1. Item wordings with reliability and validity information

Construct Item	Factor Loading	Composite Reliability	AVE
Peer usage		0.83	0.62
The majority of the colleagues in my team use the GDSS	0.80		
In my team, the GDSS is heavily employed by everyone	0.82		
A lot of my colleagues rely on the GDSS	0.74		
Competitive pressure		0.91	0.77
Our competitors' service people use GDSS-technologies extensively	0.85		
Competing service people use a lot of GDSS-technologies	0.83		
Our competitors' service people rely on GDSS-technologies in dealing with their customers	0.95		
Supervisor influence		0.89	0.73
My immediate supervisor explicitly supports my using of the GDSS	0.83		
My immediate supervisor truly believes in the benefits of the GDSS	0.87		
I am continuously encouraged by my immediate supervisor to use the GDSS in my job	0.86		
Customer influence		0.91	0.77
My customers show great interest when I use the GDSS	0.80		
Many of my customers like it when I rely upon the GDSS	0.93		
The fact that I use the GDSS is very appealing to my customers	0.91		
GDSS potency		0.85	0.53
Our team has confidence in its ability to make decisions using the GDSS	0.71		
This team can take a lot of decisions using the GDSS	0.79		
With the help of the GDSS, no decision is too difficult for our team	0.70		
Our team feels it is able to support any decision it has to take using the GDSS	0.71		
Our team expects to be known as a unit that uses the GDSS effectively	0.73		
Role-prescribed service performance		0.88	0.59
I perform all those tasks for customers that are required for him/her	0.75		
I meet formal performance requirements when serving customers	0.84		
I fulfill responsibilities to customers as specified in my job description	0.87		
I adequately complete all expected customer-service behaviors	0.84		
I help customers with those things which are required of him/her	0.79		
Service innovation support		0.91	0.67
I often go above and beyond the call of duty in exploring new service solutions	0.81		
I solve customer problems in an innovative way that goes beyond standard solutions	0.74		
I assist customers in exploring innovative service solutions, even if it means going beyond job requirements	0.79		
I am willing to go out of my way to provide customers with innovative service solutions	0.74		
In addition to my regular service tasks, I frequently come up with suggestions for service improvement for customers	0.76		
GDSS effectiveness		0.90	0.75
How would you describe the decision-making process you and your team members experience using the GDSS?			
Inefficient - Efficient	0.82		
Confusing - Understandable	0.95		
Satisfying - Dissatisfying	0.83		

(continued on next page)

Cooperation		0.85	0.60
Our team members want each other to succeed	0.82		
Our team members seek compatible goals	0.83		
The goals of team members go together	0.72		
When our team members work together, we usually have common goals	0.71		

4.4. Data analysis and results

4.4.1. Validity and reliability

To verify the validity and reliability of the measures a measurement model was estimated at the individual level (Anderson and Gerbing, 1988). Factor loadings of the confirmatory factor analysis (CFA) were obtained using the robust maximum likelihood estimator in AMOS 5.0. This analysis showed satisfactory global fit measures: $\chi^2(491) = 785.9$; CFI = 0.93; TLI = 0.92; RMSEA = 0.06; SRMR = 0.06. All items loaded significantly on the hypothesized latent variables, providing evidence for convergent validity (Anderson et al., 1988). Composite reliability values are all above the commonly suggested threshold of 0.7 (Nunnally, 1978). To check for discriminant validity, we applied the Fornell and Larcker (1981) test. This requires the square root of the average variance extracted (AVE) of each construct to exceed the correlation shared between the latent construct and other latent constructs in the model. As can be seen in Table 4.2, representing correlations among variables, all latent constructs pass the test.

Table 4.2. Correlation table with square root of AVE on diagonal

	PU	CP	SI	CI	GDSSP	RPSP	SIS	GDSSE	COOP
PU	*0.79*								
CP	0.19	*0.88*							
SI	0.44	0.15	*0.85*						
CI	0.30	0.14	0.30	*0.88*					
GDSSP	0.33	0.23	0.10	0.18	*0.73*				
RPSP	0.33	0.23	0.14	0.20	0.51	*0.82*			
SIS	0.21	0.10	0.06	0.15	0.39	0.40	*0.77*		
GDSSE	0.32	0.16	0.08	0.15	0.16	0.00	0.36	*0.87*	
COOP	0.22	0.06	0.25	0.20	0.21	0.09	0.25	0.09	*0.77*

PU = Peer Usage, CP = Competitive Pressure, SI = Supervisor Influence, CI = Customer Influence, GDSSP = GDSS Potency, RPSP = Role-prescribed Service Performance, SIS = Service Innovation Support, GDSSE = GDSS Effectiveness, COOP = Cooperation

4.4.2. Justification for aggregation

To estimate and compare individual-level and group-level effects of social influences on GDSS potency, the antecedents have to be split in an individual score and an aggregated group mean. Then, the individual-level component is used as a control for its group-level counterpart in a multilevel regression equation where GDSS potency serves as the dependent variable. If the group-level effect remains significant when the individual-level effect is added to the regression equation, the group-level coefficient explains incremental and unique variance in GDSS potency which cannot be captured purely by the individual-level coefficient (De Jong et al., 2005).

Two statistics commonly used to empirically justify data aggregation to higher levels are the $r_{WG(j)}$ statistic and the intra-class correlation (ICC) coefficient. The $r_{WG(j)}$ is an indicator of homogeneity of individual ratings within teams. In our study, median values were .91 for peer usage, .90 for competitive pressure, .87 for supervisor influence, .88 for customer influence, and .95 for GDSS potency. These values indicate a high degree of consistency of individual ratings within groups (James, Demaree, and Wolf, 1993). While the $r_{WG(j)}$ statistic exclusively considers differences among employee ratings within teams, the ICC coefficient concerns a ratio of between-groups variance to total variance, taking within-group variance as well as the variance between groups into account. In our study, ICC values corrected for measurement error were significant for all four social influences variables and for GDSS potency at $p < .05$. To accurately determine the effect of interdependence, it is of importance to consider the group size. This is accounted for in the ICC(2) statistic. All ICC(2) values (ranging from .50 to .64) are ≥ .50, providing evidence for reliable group means, which permits the detection of aggregate-level relationships (Bliese, 2000).

4.4.3. Multi-level analysis results

To test hypotheses 1 to 9, we applied hierarchical linear modeling analysis using MLwiN 2.02 (Rasbash et al., 2000). The findings of the multi-level analysis are presented in Table 4.3. Three models were calculated. Model 1 is the base model with individual-level and group-level variables as determinants of GDSS potency. Additionally, team size and team size squared were entered as control variables. The base model shows a higher R^2 at the group level than at the individual level, indicating that between-teams variance in GDSS potency can be better explained by

the antecedents than within-team variance. Peer usage appears to have a significant positive impact on GDSS potency at the individual level, providing support for H1. No significant effects were found for competitive pressure on GDSS potency, nor for supervisor influence on GDSS potency at the individual level, indicating that support for H2 and H3 is lacking. Customer influence did show a positive individual-level effect on GDSS potency, supporting H4. At the group level of analysis, no significant effect of peer usage on GDSS potency was found, indicating a lack of support for H5a. In contrast, competitive pressure shows a significant positive effect on GDSS potency, supporting H5b. Supervisor influence does not appear to have any significant group-level effect on GDSS potency, H5c is therefore not supported. In addition to the individual-level effect, customer influence also shows a significant effect on GDSS potency at the group level of analysis, indicating support for H5d.

Including the interaction effects of cooperation using the within-team consensus approach, the results show that the interaction effect of cooperation with peer usage does not yield any significant effect. Thus, H6a is not supported. In contrast, a significant interaction effect of within-team consensus on cooperation and competitive pressure was found, supporting H6b. The other proposed moderating effects, H6c and H6d, were not significant using the within-team method of analysis.

For the between-team consensus calculations, we observe that from an organizational perspective, teams are clustered by the product line serviced. Including the interaction effects of cooperation using the between-team consensus approach, Model 3 again showed support for H1, H4, H5b, and H5d. In addition, two significant moderation effects were found. While no empirical support was found for the between-teams consensus hypotheses involving peer usage and competitive pressure (i.e. H7a and H7b), there is a significant negative interaction of between-team consensus and group-level supervisor influence. The positive effect of group-level supervisor influence on GDSS potency is weakened if different teams have a high agreement on their internal level of cooperation. This runs counter to the direction hypothesized in H7c. Second, the interaction of between-teams consensus on cooperation and group-level customer influence shows a significant effect. The positive effect of group-level customer influence is therefore strengthened if members of different teams agree that their cooperative climates match. This yields support for H7d.

Table 4.3. Multi-level analysis results

	Model 1 Coeff. (s.e.)[a,b]	Model 2 Coeff. (s.e.)[a,b]	Model 3 Coeff. (s.e.)[a,b]	Hyp.
Intercept	5.818 (.331)	6.035 (.327)	5.751 (.362)	
Control variables				
Team size	-.019 (.076)	-.035 (.074)	.040 (.080)	
Team size squared	.001 (.004)	.000 (.004)	-.004 (.004)	
Individual-level variables:				
Peer usage	.118 (.060)*	.119 (.060)*	.114 (.059)*	H1
Competitive pressure	.049 (.050)	.052 (.049)	.049 (.049)	H2
Supervisor influence	-.058 (.046)	-.057 (.046)	-.064 (.045)	H3
Customer influence	.091 (.048)*	.092 (.048)*	.092 (.047)*	H4
Group-level variables:				
Peer usage	-.112 (.150)	-.044 (174)	-.170 (.195)	H5a
Competitive pressure	.273 (.122)*	.286 (.131)*	.363 (.131)**	H5b
Supervisor influence	.089 (.140)	.020 (.144)	.195 (.207)	H5c
Customer influence	.276 (.154)*	.362 (.156)*	.291 (.165)*	H5d
Cooperation (within team)		-.073 (.232)		
Cooperation (between teams)			-.170 (.918)	
Interactions:				
Cooperation (within team) x Peer usage (group level)		-.561 (.641)		H6a
Cooperation (within team) x Competitive pressure (group level)		1.431 (.591)**		H6b
Cooperation (within team) x Supervisor influence (group level)		.472 (.598)		H6c
Cooperation (within team) x Customer influence (group level)		-.261 (.648)		H6d
Cooperation (between teams) x Peer usage (group level)			.661 (.829)	H7a
Cooperation (between teams) x Competitive pressure (group level)			1.490 (1.065)	H7b
Cooperation (between teams) x Supervisor influence (group level)			-3.774 (1.766)*	H7c
Cooperation (between teams) x Customer influence (group level)			2.905 (1.363)*	H7d
Increase in model fit[c]:	χ^2 (10) = 27.007**	χ^2 (5) = 7.441	χ^2 (5) = 10.447	
Explained variance (%)				
Individual-level	17.5	18.8	20.1	
Group-level	51.7	52.7	53.4	

*$p < .05$; **$p < .01$.

Notes: $N_{teams} = 28$, $N_{individuals} = 198$, significance is based on one-tailed tests.

[a] *Unstandardized regression coefficients.*

[b] *Standard errors between parentheses.*

[c] *The increase in model fit relative to previous Model.*

- *The inclusion of the interaction terms does not significantly improve the fit of Model 2 compared with Model 1. We found one significant, positive interaction of cooperation within teams* x *competitive pressure at the group level. The addition of this interaction term to the model leads to a significant increase in model fit ($\chi^2(1) = 5.71$; $p < .05$), indicating support for H6b.*
- *The inclusion of the interaction terms does not significantly improve the fit of Model 3 compared with Model 1. We found one significant, positive interaction of cooperation between teams* x *customer influence at the group level. The addition of this interaction term to the model leads to a significant increase in model fit ($\chi^2(1) = 4.49$; $p < .05$), indicating support for H7d. Furthermore, we found one significant, negative interaction of cooperation between teams* x *supervisor influence at the group level. The addition of this interaction term to the model leads to a significant increase in model fit ($\chi^2(1) = 4.52$; $p < .05$)*

To test hypotheses 8, 9, 10, and 11a-c, we again applied hierarchical linear modeling analysis, using a multi-response model. Assessing the relationships between GDSS potency and its outcomes on both the individual and the group level, we estimated a multi-response model. The results show that GDSS potency significantly influences employee role-prescribed service performance and service innovation support at the individual level. This supports H8 and H9. The individual assessment of GDSS potency does not significantly affect GDSS effectiveness, indicating a lack of support for H10. On the group-level of analysis, the synergetic effects of GDSS potency have no significant effect on employee role-prescribed service performance and service innovation support. H11a and H11b are therefore not supported. There is a significant effect between the group-level assessment of GDSS potency and GDSS effectiveness, supporting H11c. For all outcome variables, the explained variance is significantly higher at the group-level of analysis, indicating that between-team variance in GDSS potency explains additional variance in the outcome measures. Details are given in Table 4.4.

4.5. Conclusion

4.5.1. Discussion

The purpose of this study was to introduce the concept of GDSS potency in the context of enhancing decision-making for service innovation by boundary-spanning service teams. We developed a conceptual model of antecedents and consequences of this collective perception. In addition, moderating effects of cooperation consensus within and between teams were taken into account.

At the individual level, both peer usage and customer influence have a positive impact on GDSS potency. Service employees noticing contributions in the data repository and discussion forums of the GDSS will translate this to group confidence perceptions. Furthermore, the needs and wants of customers can influence team decision processes. When customers show interest in the GDSS, confidence perceptions within the team are stimulated. These findings extend previous studies in which team processes were mostly hypothesized to drive customer outcome variables (e.g. Mathieu et al., 2006). This study is among the few to consider this relationship in the opposite direction (cf. Schneider et al., 2003) and underscores the recent finding by De Jong, De Ruyter, and Wetzels (2006), who find that perceived

Table 4.4. Results of the GDSS potency-outcome relationships

Multi-Response Model	Coefficient (SE)[a, b]		Hyp.
Intercept of Role-prescribed service performance	5.683 (.076)		
Intercept of Service innovation support	5.393 (.082)		
Intercept of GDSS effectiveness	5.854 (.116)		
Control variables			
Team size → Role-prescribed serv. perf.	.031 (.019)		
Team size squared → Role-prescribed serv. perf.	.002 (.005)		
Team size → Service innovation support	.019 (.020)		
Team size squared → Service innovation support	.000 (.005)		
Team size → GDSS effectiveness	-.006 (.028)		
Team size squared → GDSS effectiveness	.027 (.007)**		
Individual-level antecedent relationships			
GDSS potency → Role-prescribed serv. perf.	.558 (.081)**		H8
GDSS potency → Service innovation support	.447 (.086)**		H9
GDSS potency → GDSS effectiveness	.205 (.125)		H10
Group-level antecedent relationships			
GDSS potency → Role-prescribed serv. perf.	.111 (.279)		H11a
GDSS potency → Service innovation support	.064 (.302)		H11b
GDSS potency → GDSS effectiveness	.771 (.424)*		H11c
Residual Between-Groups Covariance Matrix[b,c]	1	2	3
1. Role-prescribed service performance	.024 (.024)		
2. Service innovation support	-.032 (.029)	.033 (.029)	
3. GDSS effectiveness	.044 (.022)	-.038 (.026)	.050 (.055)
Residual Within-Groups Covariance Matrix[b,c]	1	2	3
1. Role-prescribed service performance	.462 (.050)		
2. Service innovation support	-.035 (.057)	.505 (.055)	
3. GDSS effectiveness	.090 (.038)	.205 (.056)	1.065 (.116)
Explained variance (%)	Individual-level	Group-level	
1. Role-prescribed service performance	22.5%	34.3%	
2. Service innovation support	11.5%	27.2%	
3. GDSS effectiveness	11.8%	43.3%	
Increase in model fit[d]:	χ^2 (12) = 93.865**		
Increase in model fit[e]:	χ^2 (6) = 34.265**		

*$p < .05$; **$p < .01$.
Note: significance is based on one-tailed tests.
[a]*Unstandardized regression coefficients.*
[b]*Standard errors between parentheses.*
[c]*Unstandardized covariance coefficients.*
[d]*Increase in model fit when including the predictor variables.*
[e]*Increase in model fit when including the covariance terms among the outcome variables.*

service quality influences group potency beliefs. The individual-level effect of competitive pressure on GDSS potency was not found to be significant. It could be that some employees are relatively insensitive to influences originating from the market environment. Or, as Ancona and Caldwell (1992) state, to successfully communicate with external parties "you need to know where to go, who to see, how to talk to them, and not everyone can do that" (p. 646). In addition, the individual-level effect of supervisor influence on GDSS potency was also non-significant. It

could be that communication of the supervisor was perceived as pressuring instead of motivational. In this respect, researchers have noted that an individual's self-efficacy should be sufficiently high to reap the benefits from high management expectations (Eden et al., 1991).

At the group-level of analysis, shared perceptions among team members about the levels of competitive pressure and customer influence are important determinants of GDSS potency. As team members share information on the market environment, they develop a shared sense of the service (innovation) level that the competition offers to its clients. Service employees may not have the ability to picture this situation individually, but a *joint* understanding of the urgency to use the GDSS can develop a higher sense of GDSS potency. In addition, if team members share the understanding that the customers are favorable towards GDSS-based service delivery, this will boost confidence perceptions. Peer usage and supervisor influence did not have any synergetic group-level effects on GDSS potency. As every member knows whether their peers are using the GDSS or not, no social processes are needed to inform an individual member of his/her direct work environment. In addition, boundary-spanning teams are relatively autonomous, so that the influence of a supervisor does not significantly contribute to GDSS potency beliefs. In sum, we identify two synergetic, social processes within the boundary-spanning teams which build GDSS potency. These motivational effects can arise from a "we are in it together" mentality, which has been shown to be important in enhancing team innovativeness, adaptability, and learning (Edmondson, 1999; Tjosvold, Yu, and Hui, 2004; West and Anderson, 1996). Moreover, a shared understanding of normative influences can be regarded as evidence about the team's effectiveness (cf. Kelman, 1958), boosting confidence perceptions.

Furthermore, we analyzed whether these synergetic group effects are enhanced by team-member consensus on how cooperative their team is. Both within-team and between-team cooperation consensus were considered. Findings indicate that within-team cooperation consensus strengthens the positive effect of competitive pressure on GDSS potency. Hence, especially in a highly competitive environment, competitors using new technologies will be seen as a challenge for further self-improvement if the climate within the team is cooperative. This result is in alignment with findings by Tjosvold and colleagues (Tjosvold et al., 2004; Tjosvold and Tsao, 1989) who report that a cooperative structure builds commitment and strategic adaptability. It also adds to recent literature investigating the moderating role of

cooperation. For instance, where Beersma et al. (2003) show interaction effects of *personal* characteristics and cooperation influencing team performance, we show that cooperation can also be a precondition for *social* influences to take effect.

Interestingly, studying the between-team moderation results reveals a different picture. When multiple teams share an understanding of how their members cooperate, this facilitates inter-team communication. Multiple teams may share insights in customer demands which allows them to be better informed on customer satisfaction of the GDSS supported service delivery. Additionally, while we expected that more between-team agreement on cooperation would reduce conflict and thereby make supervisor influence more effective, the guidance of a team supervisor becomes less salient when teams develop a shared identity. Possibly, information on work practices, market scenarios, and responsibilities can be obtained from similar teams. This finding parallels conclusions of the contingency theory of leadership. For instance, the normative decision model of leadership by Vroom and Yetton (1973) advocates leaders to allow subordinates more influence in decision-making if they share organizational goals. Additionally, Kabanoff and O'Brien (1979) show that leader ability does not affect productivity in groups where collaboration and coordination were higher. Hence, in situations of high cooperation, a leader can give a team more autonomy since personal interdependence replaces hierarchical governance mechanisms.

Finally, on an individual level, GDSS potency influences role-prescribed service performance and service innovation support of boundary-spanning employees. In contrast, shared group-level perceptions of GDSS potency do not affect employee behavior. Therefore, service performance and service innovation support seem to be individual acts which are only influenced by self-perceptions on the team's functioning, but not by synergetic team processes. Nevertheless, previous research on new service development shows that team structures can be important to the success of new services, as overcoming uncertainties in solving complex customer problems requires functional coordination and teamwork among departments (Atuahene-Gima, 1996). We consequently conclude that front-line employees are relatively autonomous, so that potency perceptions do not have to be *shared* among team members to influence innovative behavior. In contrast, the effectiveness of the GDSS seems to be driven by the shared understanding of team members on their team's level of GDSS potency. This indicates that GDSS technology is only effective when the team as a whole shares a confidence in its capabilities. Hence, group

synergetic effects are essential to improve work and decision processes with the help of a GDSS.

4.5.2. Limitations and future research directions

Our study opens interesting avenues for future research, partially resulting from its limitations. First, our sample consists of cross-sectional data. Previous research has however noticed that shared perceptions such as potency can develop over time and can therefore meaningfully be studied from an longitudinal perspective (De Jong, De Ruyter, and Wetzels, 2006). Studying the concept of GDSS potency and its antecedents over time thus remains a challenge for future research.

Second, in our study we have specifically modeled social influences as antecedents of GDSS potency, inspired by seminal works of Bandura (Bandura, 1986; 1997). However, other factors such as management support and previous performance are likely to influence confidence perceptions as well (De Jong et al., 2005; Gully et al., 2002). Hence, future studies could translate these general insights into a virtual boundary-spanning team context by testing these factors as drivers of GDSS potency.

Third, our outcome measures are perceptual in nature. Future studies should aim for objective data to see whether GDSS potency influences the time that employees are logged on to the GDSS, whether a team services more customers per month, whether problems are solved more quickly, etcetera.

As a final important direction for future research, this study indicates the relevance of studying synergetic effects within as well as between teams. With the increasing use of multi-team systems (DeChurch et al., 2006) cross-unit organizational research (individual - team, team - team, team - organization) will become even more important. It would therefore be interesting to more deeply explore what is the influence of synergetic processes in these settings. For instance, besides the factor cooperation we conceptualize, elements like social and managerial support deserve attention (De Jong et al., 2005).

4.5.3. Managerial implications

From a managerial point of view, our findings yield interesting insights for business practice. This study shows that perceptions of GDSS potency within virtualized

boundary-spanning service teams can be essential in ensuring that employees display role-prescribed service performances, but also go the extra service innovation mile when needed. We note that these behaviors are individual acts, which are primarily affected by self-perceptions of the team's collective confidence. Hence, a manager can target his efforts to individual boundary-spanning team members when stimulating role-prescribed and innovative service behaviors. Previous literature therefore stresses the integration of innovation activities in recruitment and development activities in achieving new service development success (Atuahene-Gima, 1996). The recruitment procedure could include personal assessments on a person's perseverance and creativity. In development activities, offering individual IT training or task-focused feedback programs are viable options. Also, company incentives schemes need to be aligned to reward individual employees for ambidextrous performance, i.e., stimulating both service performance and innovation at the same time. To enhance the effectiveness of the GDSS in service teams, there needs to be a *shared* perception on the level of GDSS potency within the team. Hence, GDSS is a technology which can only effectively support work and decision processes when the team *as a whole* has confidence in its capability to support the team. Therefore, managers need to make team members aware of this observation by targeting their efforts to enhance potency to all team members simultaneously. This could be done by group exercises using the GDSS, or simulate the joint handling of complex customer problems in role-playing exercises.

To enhance individual perceptions of GDSS potency, managers can use team synergetic, social processes to their advantage. As not every team member is equally sensitive to developments in his/her external environment, management can speed up the group awareness of the environment by monitoring competitors' developments and make the team aware of their knowledge. However, this should be carried out in a constructive manner. Raising the bar of expectations too high may backfire in terms of anxiety and doubts regarding a team's belief in it’s own competences. Therefore, managing employee self-confidence can be important as well. In addition, if customers like the GDSS-supported service delivery, this is a major source of team confidence perceptions. Hence, a company could advertise their service to customers as being very innovative. For instance, advertisements could contain pictures of a team working with the technology in order to prepare customers for the experience. Additionally, explaining the benefits of the GDSS to customers allows them to anticipate on the type of service to be received.

As another insight, management should make sure that team members have common goals and are willing to work toward them. Consensus on the level of team cooperation allows members to find motivational effects in competitive pressure. Effective methods for achieving cooperation are training the skill of team discussion and the skill of reorganizing internal functioning when barriers arise (Tjosvold et al., 2004). To promote consensus, group exercises aimed at the identification of strengths can be advised. While each team deserves individual attention, cooperation consensus should also be managed within teams across different business units. Ensuring that multiple teams share goals and are willing to work toward them creates a shared social identity among the teams in a multi-team system. As a consequence, they are more willing to exchange information and integrate their knowledge, increasing the positive effect of customer influence on GDSS potency. Management should therefore consider job-rotation schemes and the introduction of cross-team projects.

As a final interesting implication, if multiple teams have similar views on their internal level of cooperation, this reduces the need for strong supervisor team guidance. The coordinating and supporting hierarchical mechanism of supervision is then partially replaced by the shared identity on cooperation between the teams. This allows managers to direct their efforts more towards managing the external social influences of competitive pressure and customer influence.

Chapter 5

General conclusion and future research

This final chapter provides the main conclusions that arise from the three empirical studies described in the previous chapters of this dissertation. In addition, an integrated perspective across the studies is described by discussing three different themes: 1) Individual and group-level effects, 2) Setting characteristics and social team processes, and 3) Moderating effects. Finally, possible future research avenues are considered.

5.1. Synopsis

The research perspective taken in this dissertation is motivated by the observation that social influences and processes have been a relatively underresearched aspect in the field of service technology adoption. Based on the trend that an increasing number of service companies and service institutes use technology-supported team-based structures in their organization (Chen and Lou, 2002), this dissertation investigated organizations that have implemented groupware systems across two different settings. The focus was on service activities and problems. As these are often characterized by complexity and unclarity, team members' work attitudes and role behaviors are critical components in successful technology deployment. Therefore, this dissertation takes a broad perspective on technology adoption by also considering job attitudes and role behaviors.

Chapter 1 stated that the central research problem is defined as: *What is the impact of social influences and processes on service technology adoption?* In addition, specific objectives were developed for each separate chapter. Chapter 2 sets the stage for the subsequent chapters by concluding that subjective norm is an important factor in individual decisions to adopt a new technology. Since people in an organization influence each other, the relevance of organization-wide support was stressed, creating a shared vision and allowing employee participation in decision processes. Chapters 3 and 4 elaborated on this conclusion. Chapter 3 examined a conceptual framework of psychological safety in relation to groupware supported university student teams. Built on organizational learning literature and perceived organizational support theory, a conceptual model was developed from an affective perspective. Chapter 4 investigated antecedents and outcomes of GDSS potency in a context of boundary-spanning high-tech service teams. A cognitive approach was taken to relate social influences and confidence perceptions to GDSS outcomes and employee performance behavior. In sum, first this dissertation has indicated the importance of social influences in technology adoption. Thereafter, two studies considered two different service settings in which groupware was applied. The differences in settings and theoretical perspectives give rise to a comprehensive and multi-faceted understanding of social influences and processes in service technology adoption.

This final chapter provides a general overview of the findings that have been discussed in the separate chapters. First, section 5.2 reports the most important

conclusions of the chapters with respect to the objectives that were formulated in the introduction. Second, based on these findings, an integrated perspective is presented in section 5.3, developing an integral vision on the topic of social influences and processes in service technology adoption that goes beyond the conclusions that were drawn on the basis of the individual chapters. The chapter concludes with discussing possible future research avenues.

5.2. Main conclusions of the chapters

5.2.1. Chapter 2

The objectives formulated to acquire a general understanding of social influences in previous academic research in the field of technology adoption were: 1) *provide clarity on the TAM literature with regard to the effects of subjective norms*, and 2) *determine whether the effects are different across research settings.* By means of a quantitative meta-analysis, large effect sizes (Cohen, 1988) were found for the correlations between subjective norm and behavioral intention, and between subjective norm and perceived usefulness. The effect of complying to others' opinions, i.e. the relationship between subjective norm and behavioral intention, was found to be more prominent in Western versus non-Western settings. The effect of internalizing others' opinions as evidence about the reality, i.e. the relationship between subjective norm and perceived usefulness, was found to be stronger for students versus non-students, as well as for non-microcomputer versus microcomputer studies. In general, students displayed stronger effect sizes in all but three correlation pairs of variables. Additionally, correlations were generally lower in a microcomputer setting compared to a non-microcomputer setting.

5.2.2. Chapter 3

Chapter 3 elaborated on the construct of psychological safety by developing a conceptual model of antecedents and consequences from an affective perspective. The objectives were: 1) *to develop a conceptual framework of antecedents and consequences of psychological safety*, 2) *to determine whether psychological safety is an important driver of service technology adoption*, 3) *to explore the effects of group-level and individual-level antecedents on psychological safety*, 4) *to investigate whether these effects are contingent on the level of an individual's self-consciousness*, and 5) *to investigate whether the effects of psychological safety on service technology adoption are contingent on the level of offline*

communication students report. The following conclusions arise from this study. First, psychological safety was found to impact both perceived usefulness and perceived ease of use of the groupware system, apart from showing a *direct* positive effect towards groupware usage. As a second important finding, tutor support and peer support enhance feelings of psychological safety at the individual level of analysis. In addition, shared group-level perceptions on the level of tutor support within a team are an important determinant of psychological safety. Third, findings illustrate that for more self-conscious individuals, the shared group-level perceptions on the level of peer support within a team become more salient. Finally, an important finding of this study is that offline communication with tutors and peers can strengthen the positive effects of psychological safety for an individual.

5.2.3. Chapter 4

Chapter 4 takes a cognitive perspective and proposes the construct of GDSS potency to have an important influence in service technology adoption. The objectives of chapter 4 were: 1) *to develop a conceptual framework of antecedents and consequences of GDSS potency*, 2) *to determine whether GDSS potency is an important driver of service employee performance and GDSS effectiveness*, 3) *to explore the effects of group-level and individual-level antecedents on GDSS potency*, and 4) *to investigate whether these effects are contingent on the level of within-team and between-team cooperation variability.* First, the results show that peer usage and customer influence have positive individual-level effects on GDSS potency. Second, there are positive synergetic group-level effects of competitive pressure and customer influence on GDSS potency. In addition, if team members share the understanding of customer demands, this will boost confidence perceptions beyond the individual-level effect of customer influence. As a third finding, consensus among service team members on their level of cooperation strengthens the positive effect of competitive pressure on GDSS potency. Additionally, high consensus between different teams on the level of cooperation within the teams strengthens the positive impact of customer influence on GDSS potency, but dampens the positive effect of supervisor influence. Finally, the findings show GDSS potency relates positively to role-prescribed service performance and service innovation support on an individual level. However, to enhance the effectiveness of a GDSS, potency perceptions need to be shared among the team members.

5.3. An integrated perspective

By means of three studies this dissertation addressed the topic of social influences and processes in service technology adoption. From a meta-analytical perspective, the first study gives an overview of the status quo situation of subjective norm in technology adoption. Given the importance of subjective norm, the results of chapter 2 imply that technology adoption is a social process. In fact, social processes are of paramount importance in influencing individual technology adoption. In forming their perceptions or intentions towards a new technology, individuals are often influenced by their social environment, e.g. colleagues and superiors (Harrison, Mykytyn, and Riemenschneider, 1997; Karahanna and Limayem, 2000; Taylor and Todd, 1995). In teams working towards a common goal, these social influences could be even more salient (Smith, Terry, and Hogg, 2006). Therefore, with the increasing use of organizational teams to tackle complex tasks guided by technological advances (Mathieu et al., 2000), chapters 3 and 4 deepen insights into social influences and processes in technology adoption from different theoretical points-of-view. Across these two latter studies, several issues can be identified which are suitable for further discussion. In the following, three themes are raised which deserve additional attention.

5.3.1. Theme 1: Individual- and group-level effects

As team members share the workload, monitor work behavior of other members, and develop and contribute expertise on subtasks, they construct their own norms and shared views (Martin, 1992; Mathieu et al., 2000). Therefore, chapters 3 and 4 accounted for the observation that besides individual differences in the assessment of social influences, there could also be differences between teams. Literature suggests several different social mechanisms that underlie the convergence of opinions within a specific team and the divergence in shared beliefs between teams (De Jong and De Ruyter, 2004). First, cognitive dissonance theory (Festinger, 1954) states that individuals try to minimize psychological discomfort caused by inconsistencies between one's own beliefs and those of one's reference group. While this can be achieved in different ways, self-presentation theory (Goffman, 1959) states that in interpersonal situations, people interact with each other through tacit agreements on who they are and what they are doing. As such, people play a role which is expected in a specific social situation. These socially appropriate interactions may vary *across* teams, but convergence *within* a team is likely to happen due to social desirability (cf.

Fisher, 1993). Second, groupthink may occur within highly cohesive groups (Janis, 1982). In order to minimize conflict, members of a group try to reach consensus on an issue without critically analyzing alternative courses of action. This is more likely to happen when the group is under pressure to make a quality decision, or to meet a high standard of performance. In these situations, individual opinions converge without conscious awareness. Third, social identity theory states that belonging to a social category provides members with a social identity (Tajfel and Turner, 1985). The process of categorization, identification, and comparison creates favorable perceptions and actions towards the in-group at the expense of the out-group. This in-group favoritism is an important psychological basis of inter-group discrimination.

In sum, there are several social processes and mechanisms underlying what Cattell (1948) calls "syntality": those activities that synergetically combine to make a group a unique entity. Chapters 3 and 4 show that synergetic social influences explain a significant amount of extra variance in employee outcomes beyond individual-level assessments. For example, in explaining an employee's psychological safety, individual-level support perceptions explained 22.4% of variance, while including group-level shared perceptions explained up to 51.7% of variance. Specifically, results indicate that the student groups in the sample perceived that their tutor treated them as a group, rather than a collection of individuals. Hence, a "we are in it together" mentality sparked feelings of safety and stimulated participation in the group decision processes. Similarly, the last study shows that in explaining an employee's assessment of the team's GDSS potency, individual-level variables explained only 17.5% of variance, while including synergetic group-level effects yielded 51.7% variance explained. These results indicate that boundary-spanning team members especially integrate their opinions on social influences which originate from outside the organization's boundaries since competitive pressure and customer influence have a positive impact on GDSS potency at the group-level of analysis. As a final illustration of the differential effect of group-level effects, the effectiveness of a GDSS is only significantly influenced by shared group-level perceptions of GDSS potency. Individual perceptions were not found to be significant in influencing effectiveness.

Comparing the two studies described in chapters 3 and 4, the results suggest that social influences which are external of a team's most prominent boundaries become more salient in influencing team processes if team members have shared beliefs on

these influences. For a student team, the most prominent boundary is team membership. Social influence from outside the team, such as support from a tutor, is more effective when team members integrate their opinions on this source. For a boundary-spanning team, not communicating face-to-face as regular as a collocated team, the most prominent boundary is organizational membership. Here, social influence from outside the organization, such as from competitors or customers, is more effective when team members integrate their opinions on this source. This opens an interesting avenue for future research.

5.3.2. Theme 2: Setting characteristics and social team processes

As indicated, the settings of chapters 3 and 4 differ on several accounts. First, while the university in chapter 3 is a nonprofit organization, the high-tech company in chapter 4 is established on for-profit principles. Several characteristics set nonprofit organizations apart from for-profit firms. Allison and Kaye (2005) and Gallagher and Weinberg (1991) state that these differences cause challenges for marketeers and consultants. To begin with, nonfinancial objectives and a passion for the mission make it problematic to measure progress or evaluate concrete outcomes. Second, many nonprofit and public organizations are dependent on third party funding and have no financial risk cushion to take initiatives themselves. In an extreme case, the funding party might drive the nonprofit's programs without much commitment of the organization's members. Third, the nonprofit culture is often typified by the lack of attention to hierarchy, a sense of friendliness, and a welcoming atmosphere. Together, these nonprofit characteristics might cause both tutors and students to think that the introduction of groupware technology is uncalled for, making its adoption more problematic. Being critical on the necessity of the groupware, negative attitudes towards the system will develop more easily. However, in the for-profit situation, this is counterbalanced by the fact that adoption of the technology is mandatory. As a result, team members might *use* the technology, but they may not really *like* it, undermining job satisfaction, organizational commitment, and hence the total groupware effectiveness (Zuboff, 1988).

The differences in profit structures across the two situations thus give rise to the distinction between mandatory and voluntary use. The students in chapter 3 had a higher degree of voluntariness in using the groupware technology compared to the employees in chapter 4. The latter group was largely virtual in nature and had face-to-face meetings only occasionally. Team members were oftentimes out of office to

service products at a client. They were dependent on the GDSS technology for their interpersonal communication and data exchange. In contrast, the students had more face-to-face contact and also met each other during other courses at the same university. These alternative modes of communication make their groupware system a convenience tool, while the boundary-spanning team existed *because* of their GDSS system.

Brown et al. (2002) state that determinants of technology use may vary with different levels of voluntariness, so that subjective norm and individual confidence perceptions have an important impact on behavioral intention when use is mandated. This is in line with the foundations of the Theory of Planned Behavior (TPB), which states that in order to predict the performance of behavior which is not completely voluntary, it is important to account for the levels of personal control an individual perceives in this situation. More specifically, perceived behavioral control can be defined as the individual's perceptions of "…the presence or absence of requisite resources and opportunities" (Ajzen and Madden, 1986, p. 457) necessary to perform the behavior. As an important part of this judgment is made from perceptions of the self, confidence and (self-)efficacy beliefs become essential elements in non-voluntary technology adoption situations. To reflect this line of thought, chapters 3 and 4 report two different focal variables.

Comparing the role of the two different constructs in the two studies, both variables can be seen as a team performance process in an input-process-output (IPO) model (cf. Hackman, 1987). Both team processes are driven by social influences, which act on an individual level of analysis as well as on a group level of analysis. In addition, psychological safety and GDSS potency both influence person-technology interaction. Psychological safety relates to groupware usage, while GDSS potency influences the effectiveness of a GDSS. These findings therefore add to previous technology adoption literature which mainly identified technology characteristics (Davis, Bagozzi, and Warshaw, 1989), personal characteristics (Dabholkar and Bagozzi, 2002; Venkatesh et al., 2003) and facilitating conditions (Schillewaert et al., 2005) as important adoption enhancing factors.

5.3.3. Theme 3: Moderating effects

In contrast to the classic validation model, which determines the degree of association between a (set of) predictor variable(s) and a criterion variable (Sharma,

Durand, and Gur-Arie, 1981), the use of moderator variables has become common practice in marketing, IT and organizational behavior literature. A moderator can strengthen or weaken a conceptual relationship between two other variables. In other words, a moderator can explain why effects between independent and dependent variables vary across situations, teams, or persons.

Types of moderators

Across the three studies in this dissertation, different types of moderating variables have been applied. To begin with, in the meta-analysis, three different moderator categories were derived inductively from sample characteristics of the studies used in the analysis. As such, moderating variables were defined as culture (Western versus non-Western), type of respondent (students versus non-students), and type of technology (non-microcomputer versus microcomputer). Analogous to other meta-studies, in exploring the existence of significant moderating effects, the sample was split based on the derived characteristics and applied subgroup analysis by performing equality tests between correlation coefficients of the different subgroups (cf. Damanpour, 1991; Sheppard, Hartwick, and Warshaw, 1988).

While the meta-analysis focused on sample characteristics, the study on psychological safety employed the *individual trait* of self-consciousness as a moderator of the relationship between group-level social support and psychological safety. In psychology, an important tradition of studying person-situation interactions has developed (Endler and Magnusson, 1976). Also organizational behavior literature notes that interactions between work environment and the characteristics of individuals can add explanatory power to the influence of social support on work outcomes (Lakey et al., 1996; Riolli and Savicki, 2003). Indeed, the findings based on multilevel regression analysis show that self-consciousness interacts with group-level perceived peer support in influencing psychological safety, indicating that shared perceptions of peer support do not enhance safety perceptions equally for all members of a team.

In the study on GDSS potency yet another type of moderating variable was used, besides the contextual study characteristics and the individual trait discussed earlier. The *interpersonal process* of cooperation was proposed to moderate the relationship between group-level social influences and GDSS potency. While it has been noted that relationships between team characteristics and performance can be inconsistent across research settings, the moderating role of interpersonal processes has only very

recently received research attention (De Jong, De Ruyter, and Wetzels, 2005). For example, Mohammed and Angell (2004) found that team processes like leadership, coordination, and communication moderated the link between team diversity and relationship conflict. De Jong, De Ruyter, and Wetzels (2005) find that social support consensus moderates between team tenure and group potency. In addition to the inconsistent effects of objective team *characteristics*, an increasing body of research indicates that interpersonal processes may also moderate between team member's *shared perceptions* and team or individual outcomes. For instance, Kirkman et al. (2004) found that the number of face-to-face meetings of a virtual team moderated between the shared perceptions of the team's empowerment and its performance. De Jong, De Ruyter, and Wetzels (2005) state that social support consensus moderates between shared perceptions on management and interteam support and group potency. De Dreu (2007) reports evidence for the moderating role of task reflexivity on the relationship between shared perceptions on a team's information sharing and team learning.

Regarding the moderating variables in chapters 3 and 4, this dissertation adds insights to the rising research area of multi-level studies by considering contingency effects. First, by including an individual trait as a moderator, statements can be made on which team members adhere to shared perceptions in constructing personal outcome perceptions or performances. This is relevant from a theoretical perspective, since it widens the understanding of social influences across hierarchical levels: A group-level effect may be dampened or strengthened by a member's individual characteristics. In addition, from a managerial perspective it allows identification of team members in need of extra leader attention, since team mechanisms may not yield the desired effect. Second, considering the interpersonal process of cooperation as a moderator adds to the increasing insight that interpersonal and team processes can strengthen or dampen the effects of shared perceptions in constructing personal outcome perceptions or performances. In general, these findings are in line with seminal findings by De Jong, De Ruyter, and Wetzels (2005) in that consensus on a team's interpersonal processes (i.e. cooperation) can significantly affect the strength of the relationship between social influences and team confidence perceptions.

Because of the differences in the research settings of chapters 3 and 4, it is difficult to make any definite claims on which type of moderator might have the biggest impact: individual traits or interpersonal processes. Moreover, besides the research setting, the predictor and outcome variables also differ, making a comparison virtually

impossible. However, self-consciousness (individual trait) interacts with social influences from peers, while within-team and between-team cooperation consensus (interpersonal process) interact with all sources of social influence, *except* that of peer usage. It might be that team members are perfectly able to make individual judgments on the supportiveness of their peers, while they need a cooperative group process to grasp social influences originating outside the circle of direct colleagues. However, the underlying sample is relatively small to draw any unambiguous claims, and this is therefore an interesting avenue for future research.

Operationalization

In operationalizing the moderating variable of cooperation, the dispersion model of composition was used to reflect the extent of synergy in this interpersonal process. A composition model explains how a construct operationalized at one level of analysis translates to another form on a different level of analysis. Chan (1998) proposed five different models of composition in his typology. First, in the additive model, the meaning of the higher level construct is a summation or average of the lower level unit scores regardless of the variance among these units. Second, the direct consensus model is one of the most popular forms of composition among multilevel researchers. In contrast to the additive model, variance among lower level units is important, since within-group agreement of scores is a necessary precondition to represent scores at a higher level. Third, the referent-shift consensus model is similar to the direct consensus composition, with the critical difference that the lower level attributes are conceptually distinct since they have a different referent. For example, they do not refer to the self, but to members of the team. Fourth, process models are used when there is an interest in the process as opposed to some stable attributes, outcomes, or state of affairs. Here, process parameters at the higher level are analogues of the process parameters at the lower level. Finally, in dispersion models, instead of treating within-group variance as error variance and a statistical prerequisite for aggregation, the degree of within-group agreement of scores from lower level units is conceptualized as a focal construct. Where the direct consensus model focuses on members' average responses, which could be called *climate quality*, the dispersion model assesses the variance in members' climate perceptions, which can be termed *climate consensus* or *climate strength* (Lindell and Brandt, 2000; Schneider, Salvaggio, and Subirats, 2002).

Recent research suggests that consensus measures have the potential to better moderate predictor-outcome relationships in team-based research compared to a

quality or average response measure (De Jong et al., 2005). While the impact of these two types of moderator operationalization has not been compared, this dissertation does adhere to another recent trend in team research. Within large organizations, the rise of multiteam systems has sparked research interest in the effects of any form of ties between different teams (DeChurch and Marks, 2006). Until now, many studies have left these between-team effects unexplored. Multiteam systems are networks of teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals (Mathieu, Marks, and Zaccaro, 2001). They typically exist because of their responsiveness and adaptability to challenging performance environments, which are characterized by complexity, dynamism, novelty, and uncertainty. It is argued that the effectiveness of multiteam systems heavily depends upon how well the different units coordinate their activities. In turn, satisfactory coordination is expected to be enabled by a shared understanding, held by members of a multiteam system, of the environment and the collective responses required by its contingencies (Mathieu et al., 2001, p. 303). In combining the dispersion composition model with multiteam systems theory, chapter 4 explored the impact of different teams having similar shared opinions. Finding significant interaction effects, this provides new methodological as well as theoretical insights in the area of team research.

5.4. Future research avenues

The results described in this dissertation can be regarded as a useful step towards exploring social influences and processes in service technology adoption. Especially the consideration of both the individual and team level adds insight to existing research. However, to be able to make more definite claims on the role of social influences and processes in human-technology interaction, more research is needed. The three themes identified above can be used as a guidance for compiling a future research agenda.

Individual-level and group-level effects was the first theme described. The results suggest that social influences of which the source is external of a team or organization more heavily influence team processes if team members have shared beliefs on these influences. Future studies could therefore specifically model social influences as originating from within the team, within the organization, within the market environment, or from macro-economic forces (e.g. governmental policies). It might be that the higher the level of a source, the higher the impact of the sharedness

of perceptions within the team, business unit, or even the organization as a whole, on a consistent interpretion these information flows. For instance, suppose the *government* issues legal guidelines for a certain industry. For an individual, this might be a difficult situation to cope with. However, if team members have shared views on this new policy and are consistent in their interpretations, this unfamiliar situation will cause less interpersonal tension within the team. In contrast, if a new information system is introduced and one's *direct colleagues* offer assistance in using it, team consensus on the usefulness of this support may not contribute anything to an individual's feelings.

As a second theme, differences in settings were discussed. Clearly, groupware technology can be used to support a multitude of teams. Besides the service teams described in this thesis, Duarte and Snyder (2001) distinguish between networked teams, parallel teams, project or product-development teams, work or production teams, management teams, and action teams. The technology also enables new forms of collaboration such as the involvement of customers in a new product development team, performing "co-creation of value" (Nambisan and Baron, 2007). The supporting technology, virtual customer environments, can provide services ranging from online discussion forums to virtual design toolkits and prototyping centers, enable firms to involve their customers in product design, product testing, and product support activities (Nambisan and Baron, 2007). As a result, future research should examine how the effects observed in the studies of this dissertation translate to different types of teams. For instance, are synergetic effects on team processes stronger for tenured teams, or for teams in the early stages of development? It might be that teams that have been together for a long period of time develop stronger shared perceptions. However, previous research has also suggested a link between tenure of team members and the rise of illegal or divergent behaviors (Williams, Fadil, and Armstrong, 2005), which potentially counterbalances positive synergetic effects. Furthermore, are synergetic effects stronger in a situation where employees work in multiple teams, or in a situation where they are assigned to one team only? With employees working in multiple teams and being influenced by multiple subclimates, it might be harder to develop shared team perceptions. On the other hand, multiteam membership makes employees more aware of different viewpoints on a certain topic, offsetting the potential negative influence of groupthink.

Considering the different types of moderating effects, future work could investigate what type of variable has the potential to have the biggest impact on synergetic

predictor-outcome relationships: individual traits or interpersonal processes. Even more insightful, future studies could use different types of composition models (e.g. direct consensus versus dispersion models) to operationalize the moderating variables. For instance, calculating a team's dispersion on individual traits or perceptions enables to analyze team diversity in many different perspectives compared to the traditional demographic factors. In this respect, Mohammed and Angell (2004) state that such *deep-level diversity*, or differences with respect to attitudes, personality, and values, can significantly affect the experiences of the individuals within a team. In their study they relate diversity in perceptions on time urgency and extraversion to relationship conflict within student teams. As they state though, "future research should continue to expand the range of diversity dimensions to include behavioral styles, values and beliefs" (p. 1035).

Besides the three themes defined above, a final challenge for future research arises from a limitation of chapters 3 and 4 in this dissertation. In assessing the roles of psychological safety and GDSS potency, a cross-sectional, self-report design was used. Future studies should aim to collect data from different sources. For instance, the level of interpersonal support within a team could be assessed by a team's supervisor. Furthermore, objective data measuring team or individual performance could be used in the analyses. The usage of a groupware system may be measured by log files displaying statistics on member activity. As another example, innovative ideas produced by a team can be identified by examining minutes of meetings. Consequently, these innovations can be rated on dimensions such as magnitude, radicalness, novelty, and benefit (West and Anderson, 1996). As a final research design alternative, future studies could use labor-intensive etnographic research. When used in combination with external team ratings (e.g. supervisor perception), this allows for a contrast to be made between an emic and an etic perspective on team processes. An emic perspective refers to the way the members of the team envision their world, whereas an etic perspective is the outsiders' interpretation of the experiences of that team. Such approaches would further substantiate the impacts of social influences and processes in technology adoption.

Appendix A

Author	Sample	Sample category	Respondents	Population	Country	Culture
Adams, Nelson, and Todd (1992)	Electronic & Voice mail	Non-microcomputer	118 respondents, 10 organizations, from clerical to senior management	Non-students	USA	Western
	Microcomputer software packages	Non-microcomputer	73 Undergraduate and MBA students	Students	USA	Western
Agarwal and Karahanna (2000)	World wide web	Non-microcomputer	288 students of a junior level statistics class of large state university	Students	USA	Western
Agarwal and Prasad (1998)	Specific information systems application	Non-microcomputer	76 salespeople and order correspondents	Non-students	USA	Western
Aladwani (2002)	Transactional web sites	Non-microcomputer	387 web users	Non-students	USA	Western
Al-Khaldi and Al-Jabri (1998)	Computer	Microcomputer	238 undergraduate students	Students	Saudi Arabia	Non-western
Anandarajan, Igbaria, and Anakwe (2002)	Computer	Microcomputer	143 employees of 9 organizations	Non-students	Nigeria	Non-western
Chang (2004)	Intranet use of an educational institution	Non-microcomputer	370 students and staff members of a university	Students	USA	Western
Chau and Hu (2002)	Telemedicine technology	Non-microcomputer	408 physician practicing in public tertiary hospitals	Non-students	Hong Kong	Non-western
Cheung, Lee, and Chen (2002)	Internet-based learning medium (ILM)	Non-microcomputer	549 undergraduate students of a local university	Students	Hong Kong	Non-western
Dabholkar (1996)	Computerized touch screen to order fast food	Non-microcomputer	204 undergraduate students of a large university	Students	USA	Western
	Computerized touch screen to order fast food	Non-microcomputer	186 undergraduate students of a large university	Students	USA	Western
	Computerized touch screen to order fast food	Non-microcomputer	115 undergraduate students of a large university	Students	USA	Western
Davis et al. (1989)	Two applications: Electronic mail & XEDIT	Non-microcomputer	184 professionals	Non-students	Canada	Western
	Two IBM PC-based graphic systems	Non-microcomputer	80 evening MBA students	Students	USA	Western
Devaraj, Fan, and Kohli (2002)	Web sites for online shopping	Non-microcomputer	134 on-line shoppers	Non-students	USA	Western
Dyba, Moe, and Mikkelsen (2004)	Electronic process guides (EPG's)	Non-microcomputer	97 software developers in a medium-sized software company	Non-students	Norway	Western
Featherman and Pavlou (2003)	EIectronic bill presentment and payment	Non-microcomputer	214 undergraduate business students of a large university	Students	USA	Western
	EIectronic bill presentment and payment	Non-microcomputer	181 undergraduate business students of a large university	Students	USA	Western
Gelderman (1998)	New database system	Non-microcomputer	170 (information) managers and controllers	Non-students	The Netherlands	Western

Author	Sample	Sample category	Respondents	Population	Country	Culture
Henderson and Divett (2003)	Electronic supermarket	Non-microcomputer	247 customers of a home shopping service	Non-students	Australia	Western
Henderson, Rickwood, and Roberts (1998)	Electronic supermarket	Non-microcomputer	65 customers of a home shopping service	Non-students	Australia	Western
Hsu and Liu (2004)	Online games	Non-microcomputer	233 visitors of game related message boards	Non-students	Taiwan	Non-western
Igbaria and Iivari (1995)	Microcomputer	Microcomputer	450 professionals of the top 120 companies	Non-students	Finland	Western
Igbaria, Iivari, and Maragahh (1995)	Computer	Microcomputer	450 employees (all levels) from 81 companies	Non-students	Finland	Western
Igbaria, Parasuraman, and Baroudi (1996)	Microcomputer	Microcomputer	471 professionals and managers	Non-students	USA	Western
Igbaria, Zinatelli, Cragg, and Cavaye (1997)	Personal computing in small firms	Microcomputer	358 employees in small firms	Non-students	New Zealand	Western
Koufaris (2002)	Web based store to buy books	Non-microcomputer	280 consumers	Non-students	USA	Western
Lau, Yen, and Chau (2001)	Online trading	Non-microcomputer	178 investors	Non-students	Hong Kong	Non-western
Liaw and Huang (2003)	Search engines on the internet	Non-microcomputer	114 students of a medical college	Students	Taiwan	Non-western
Lim (2002)	Computer use	Microcomputer	208 upper level business school students at a university	Students	USA	Western
Lin and Lu (2000)	Computer use	Microcomputer	145 undergraduate students	Students	Taiwan	Non-western
Liu, Tucker, Koh, and Kappelman (2003)	Online shopping (e-commerce)	Non-microcomputer	127 students and faculty members of a major university	Students	USA	Western
Lou, Luo, and Strong (2000)	Groupware technologies	Non-microcomputer	192 students of a state university	Students	USA	Western
	Groupware technologies	Non-microcomputer	193 students of a state university	Students	USA	Western
Lu, Liu, Yu, and Yao (2003)	Wireless internet via mobile technology	Non-microcomputer	128 students of a large university	Students	China	Non-western
Ma and Clark (2003)	Online course instructions	Non-microcomputer	66 students	Students	Hong Kong	Non-western
Money and Turner (2005)	Knowledge management system	Non-microcomputer	35 employees of major companies	Non-students	USA	Western
Pavlou (2003)	Online transactions	Non-microcomputer	103 undergraduate students	Students	USA	Western
	Online transactions	Non-microcomputer	155 randomly selected consumers	Non-students	USA	Western

Author	Sample	Sample category	Respondents	Population	Country	Culture
Pennington, Kelton, and DeVries (2004)	Data-analysis software application	Non-microcomputer	43 master of accountancy students	Students	USA	Western
Plouffe, Vandenbosch, and Hulland (2001)	Smart-card based electronic payment system	Non-microcomputer	167 consumers participating in a trail of the smart-card	Non-students	Canada	Western
	Smart-card based electronic payment system	Non-microcomputer	185 consumers not participating in a trail of the smart-card	Non-students	Canada	Western
	Smart-card based electronic payment system	Non-microcomputer	172 merchants participating in a trial of the smart-card	Non-students	Canada	Western
	Smart-card based electronic payment system	Non-microcomputer	80 merchants not participating in a trial of the smart-card	Non-students	Canada	Western
Riemenschneider, Harrison, and Mykytyn jr (2003)	Web use	Non-microcomputer	156 executives of small businesses	Non-students	USA	Western
Roberts and Henderson (2000)	Computer	Microcomputer	108 government workers experienced in the use of computers	Non-students	Australia	Western
Selim (2003)	Course websites as an effective learning tool	Non-microcomputer	403 undergraduate students	Students	United Arab Emirates	Non-western
Stafford and Stern (2002)	Online auctions	Non-microcomputer	329 students of 2 universities	Non-students	USA	Western
Stylianou, Robbins, and Jackson (2003)	E-commerce	Non-microcomputer	66 MBA students	Students	China	Non-western
Suh and Han (2002)	Internet banking	Non-microcomputer	845 Internet banking users of 5 major banks in Korea	Non-students	Korea	Non-western
Szajna (1996)	Computer	Microcomputer	61 graduate students	Students	USA	Western
Teo, Chan, Wei, and Zhang (2003)	Virtual learning communities	Non-microcomputer	69 freshmen students	Students	Singapore	Non-western
Teo, Lim, and Lai (1999)	Internet	Non-microcomputer	1370 internet users	Non-students	Singapore	Non-western
Venkatesh and Davis (2000)	New application software (voluntary)	Non-microcomputer	77 employees of medium sized firms	Non-students	USA	Western
	New application software (mandatory)	Non-microcomputer	79 employees of medium sized firms	Non-students	USA	Western
Venkatesh and Morris (2000)	New system for data and information retrieval	Non-microcomputer	445 employees of 5 organizations	Non-students	USA	Western
Venkatesh (2000)	New application software (voluntary)	Non-microcomputer	145 employees of a large real estate agency	Non-students	USA	Western
Venkatesh, Morris, Davis, and Davis (2003)	New application software	Non-microcomputer	215 employees of 4 organizations	Non-students	USA	Western
	New application software	Non-microcomputer	133 employees of 4 organizations	Non-students	USA	Western

Author	Sample	Sample category	Respondents	Population	Country	Culture
Yi and Hwang (2003)	New internet-based class management system	Non-microcomputer	109 students of a large state university	Students	USA	Western
Yi, Tung, and Wu (2003)	E-learning system	Non-microcomputer	201 business students of a local university	Students	Singapore	Non-western
Yuen and Ma (2002)	Computer	Microcomputer	186 students of a full-time teacher education programme	Students	Hong Kong	Non-western

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Summary

Me and You and Everyone We Know

Social Influences and Processes in Technology Adoption

Over the last years, information technology has enabled new organizational work structures, such as geographically dispersed work teams. The use of technologies supporting interpersonal communication and team collaboration is a social process, so that its value and effectiveness are determined by more people than the sole individual end-user. For instance, colleagues and supervisors can influence how an individual interacts with the technology. However, social influences and processes are relatively underresearched in existing technology adoption literature. As technology infusion in the service delivery process is even more socially complex compared to a manufacturing context because of the direct involvement of the customer, this dissertation further investigates social influences and processes in technology adoption in a service context. The central research problem is defined as: *What is the impact of social influences and processes on service technology adoption?* This question is addressed by means of three inter-related studies, in chapters 2, 3, and 4.

Chapter 2 investigates the role of subjective norm in previous research based on the Technology Acceptance Model (TAM). While this model has become the most replicated and extended model in the field of technology adoption, its social component, subjective norm, has had a rather mixed and inconclusive role over the years. A quantitative meta-analysis of previous research on TAM was therefore conducted. Furthermore, chapter 2 compares TAM results by taking into account moderating effects of one individual-related factor (type of respondents), one technology-related factor (type of technology), and one contingent factor (culture). Results indicated a significant influence of subjective norm on perceived usefulness and behavioral intention to use. Regarding moderating effects, student-based studies displayed stronger effect sizes compared to studies using non-students as respondents. Furthermore, correlations of pairwise relationships were generally lower in a microcomputer versus a non-microcomputer setting. Finally, subjective norm had a larger impact on behavioral intention in Western studies compared to non-Western studies, while perceived usefulness seemed important in Western cultures and perceived ease of use had more relevance in non-Western studies.

Chapter 3 takes an affective perspective on social influences and processes and proposes that psychological safety, a sense of interpersonal trust and being valued in a work team, is an important determinant of groupware adoption in an educational

setting. Consequently, a model of antecedents and consequences of psychological safety was developed and tested. Data were collected from 361 university students, organized in 36 teams. Results of hierarchical linear modeling reveal positive individual-level effects of perceived tutor support and perceived peer support on psychological safety. Furthermore, the findings showed a positive unique group-level effect of perceived tutor support on psychological safety, where an individual's level of self-consciousness strengthens this positive impact. In addition, findings of structural equation modeling demonstrated that both perceived usefulness and perceived ease of use partially mediate the positive effect of psychological safety on groupware usage. Finally, a student's offline communication frequency with his tutor and peers appeared to strengthen the impact of psychological safety on perceived usefulness, perceived ease of use, and groupware usage.

Chapter 4 takes a cognitive perspective on social influences and processes and examines the central role of group decision support system (GDSS) potency in the process of increasing virtualization of boundary-spanning service teams. GDSS potency is the shared perception that team members have of their joint ability to perform a wide range of service tasks using GDSS technology. A conceptual model of antecedents and consequences of GDSS potency is developed and tested. In addition, chapter 4 focuses on the moderating role of cooperation within as well as between teams. Data were collected from 198 service employees, organized in 28 teams. The results of hierarchical linear modeling reveal positive individual-level effects of peer usage and customer influence on GDSS potency. Furthermore, competitive pressure and customer influence impact GDSS potency at the group-level of analysis. Consensus on the level of cooperation within a team strengthens the group-level influence of competitive pressure, while between-team consensus on the importance of cooperation strengthens the impact that customer influence has on GDSS potency. At the same time, between-team cooperation consensus decreases the impact of supervisor influence. Finally, GDSS potency relates positively to employee role-prescribed service performance and service innovation support on the individual level of analysis. However, it affects GDSS effectiveness only if team members have a shared group-level perception of GDSS potency.

In conclusion, this research shows that social influences and processes are an important factor affecting individual attitudes to and interactions with new technology. In a service setting, where a team is supported by an information technology, both an affective and cognitive perspective can be taken. Therefore, it is

important to have pleasant interpersonal relationships within the team, as well as a shared sense of trust in the team's ability.

Nederlandse samenvatting

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Social Influences and Processes in Technology Adoption

De afgelopen jaren is informatietechnologie steeds verder opgerukt, wat onder meer heeft geleid tot nieuwe samenwerkingsvormen binnen organisaties. Een voorbeeld hiervan zijn virtuele teams, waarbij de leden niet fysiek bij elkaar hoeven te zijn om samen te werken. Het gebruik van technologie die communicatie en samenwerking vergemakkelijkt is een sociaal proces, omdat de waarde en de effectiviteit door meer mensen worden bepaald dan één enkel individu. Zo kunnen collega's of managers een invloed hebben op hoe een persoon omgaat met de technologie. Echter, sociale invloeden en processen zijn relatief onderbelicht gebleven in het huidige onderzoek op het gebied van technologieadoptie. Door de voorname rol van de klant in het proces van dienstverlening is optimalisatie van zulke processen door technologie sociaal gezien nog complexer dan in een productomgeving. Dit onderzoek gaat daarom dieper in op sociale invloeden en processen in technologieadoptie in de dienstensector. De centrale onderzoeksvraag hierbij is: *Wat is de invloed van sociale invloeden en processen op de adoptie van technologie in de dienstensector?* Door middel van drie onderling gerelateerde studies, welke besproken worden in de hoofdstukken 2, 3, en 4, wordt nader inzicht verkregen.

In hoofdstuk 2 staat de rol van subjectieve normering in bestaand onderzoek op basis van het *Technology Acceptance Model (TAM)* centraal. Subjectieve normering is de invloed van belangrijke personen op een individu om een technologie wel of niet te gaan gebruiken. Alhoewel TAM het meest toegepaste model is op het gebied van technologieadoptie, is de rol van de sociale component hierin (d.w.z. subjectieve normering) onduidelijk. Daarom is er een kwantitatieve meta-analyse uitgevoerd op basis van bestaand TAM onderzoek. Daarnaast wordt geanalyseerd of TAM resultaten verschillen wanneer het model onder verschillende omstandigheden wordt toegepast. Deze modererende effecten bestaan uit een individuele factor (het type respondenten), een technologie-gerelateerde factor (het type technologie) en een algemene factor (cultuur). De resultaten geven aan dat subjectieve normering een invloed heeft op het gepercipieerde nut van een technologie alsmede iemands intentie om de technologie te gaan gebruiken. Deze effecten zijn sterker voor studies op basis van antwoorden van studenten ten opzichte van niet-studenten. Bovendien zijn de correlaties tussen latente variabelen over het algemeen lager in studies waarbij de adoptie van een personal computer centraal stond, tegenover studies waarbij de adoptie van een andere technologie het onderwerp was. Tenslotte,

subjectieve normering vertoont een grotere invloed op gebruiksintentie van een technologie in westerse studies ten opzichte van niet-westerse studies. Daarnaast is het gepercipieerde nut belangrijker in westerse culturen, terwijl in niet-westerse culturen meer waarde wordt gehecht aan het gebruiksgemak van een nieuwe technologie.

Hoofdstuk 3 ontwikkelt een affectief perspectief op sociale invloeden en processen in technologieadoptie. In deze studie wordt verondersteld dat psychologische veiligheid, een gevoel van collegiaal vertrouwen en waardering in een team, belangrijk is in de adoptie van een *groupware* systeem in het onderwijs. Derhalve wordt een model ontwikkeld met oorzaken en gevolgen van psychologische veiligheid. Voor het testen hiervan zijn data verzameld bij 361 universitaire studenten, welke samenwerken in 36 verschillende groepen. De met hiërarchisch lineair modelleren verkregen resultaten tonen aan dat psychologische veiligheid wordt vergroot door een hogere gepercipieerde ondersteuning door een leraar en een hogere gepercipieerde ondersteuning door medestudenten. Deze effecten doen zich voor op het individuele niveau van de analyse. Daarnaast vertoont de ondersteuning door een leraar ook een positief effect op psychologische veiligheid wanneer de analyse op groepsniveau wordt uitgevoerd. Dit effect wordt nog versterkt wanneer een student een hoge mate van zelfbewustzijn heeft. De gevolgen van psychologische veiligheid zijn berekend op basis van *structural equation modeling*. De resultaten tonen aan dat het gepercipieerde nut en het gepercipieerde gebruiksgemak beide gedeeltelijk mediëren tussen psychologische veiligheid en het gebruik van het systeem. Tenslotte, de mate van *offline* communicatie tussen de student en zijn leraar en medestudenten versterkt de invloed van psychologische veiligheid op het gepercipieerde nut, het gepercipieerde gebruiksgemak, en het uiteindelijke gebruik van het groupware systeem.

Hoofdstuk 4 ontwikkelt een cognitief perspectief op sociale invloeden en processen in technologieadoptie. Deze studie bestudeert de centrale rol van *group decision support system (GDSS) potency* in het process van de toenemende virtualisatie van dienstverlenende teams. GDSS potency is de gedeelde perceptie die teamleden hebben van hun gezamenlijke talent en capaciteit om een grote diversiteit aan dienstverlenende taken uit te voeren, gebruik makend van een GDSS. Derhalve wordt een model ontwikkeld met oorzaken en gevolgen van GDSS potency. Daarnaast wordt aandacht geschonken aan de modererende rol van samenwerking binnen en tussen teams. Voor het testen van dit model zijn 198 dienstverlenende

medewerkers van een hightech bedrijf ondervraagd, welke samenwerken in 28 verschillende teams. De met hiërarchisch lineair modelleren verkregen resultaten tonen aan dat er positieve effecten zijn van systeemgebruik door collega's en meningen van klanten op GDSS potency. Deze effecten doen zich voor op het individuele niveau, terwijl op groepsniveau concurrentiedruk en meningen van klanten een positieve invloed hebben op GDSS potency. Eensgezindheid over het niveau van samenwerking binnen een team versterkt het effect van concurrentiedruk op groepsniveau. Eensgezindheid tussen de teams over het onderlinge niveau van samenwerking versterkt het effect van meningen van klanten op groepsniveau, terwijl dit juist het positieve effect van de invloed van de manager verzwakt. Tenslotte vertoont GDSS potency een positieve invloed op de door de medewerkers uitgevoerde voorgeschreven dienstverlening. Daarnaast is er ook een positief effect op de mate waarin de medewerkers innovatieve diensten aanbieden. Deze effecten doen zich voor op individueel niveau. Om een GDSS daadwerkelijk effectief te laten werken is er een gedeelde groepsperceptie van GDSS potency nodig.

Concluderend toont dit onderzoek aan dat sociale invloeden en processen een belangrijke invloed hebben op individuele houdingen ten opzichte van nieuwe technologie. In de dienstverlenende sector, waar een team ondersteund kan worden door informatietechnologie, kan zowel een affectief als een cognitief perspectief worden ingenomen. Derhalve is het belangrijk om een prettige samenwerking tussen collega's in een team te hebben, alsmede een gedeeld vertrouwen in de potentiële prestaties van dit team.

About the author

Jeroen Schepers was born on November 2, 1980 in Roosendaal, the Netherlands. After completing secondary school at Gertrudiscollege in Roosendaal (1993-1999), he studied at the Faculty of Economics at Tilburg University, The Netherlands. In July 2003 he obtained a cum laude Master's Degree in Information Management. In January 2004 Jeroen started working as a PhD candidate at the department of Organization Science and Marketing at the Faculty of Technology Management of Eindhoven University of Technology, The Netherlands. During this time, he worked on his dissertation "Me and you and everyone we know: Social influences and processes in technology adoption". His research projects have been published in journals such as *Information & Management*, *Journal of Service Research*, *Computers & Education*, and *Managing Service Quality*. Furthermore, he has presented papers and contributed to proceedings of the *European Marketing Academy Conference* and the *INFORMS Marketing Science Conference*. Additionally, under his supervision, Maurits van 't Land won the Dutch Marketing Thesis Award 2007.

As of January 2008, Jeroen will continue working at the department of Organization Science and Marketing at the Faculty of Technology Management of Eindhoven University of Technology, as an assistant professor. His main research interests include end-user adoption of information technology, the impact of new technology on service systems and structures, new service and product development, quality of service delivery, and social processes within teams.

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