DOCTORAL DISSERTATION

Leadership and Creativity in Research
Investigations of Leadership and Leader-Member Exchange (LMX) in Research Groups

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Abstract

Olsson, L. (2012). *Leadership and Creativity in Research. Investigations of Leadership and Leader-Member Exchange (LMX) in Research Groups.* Department of Psychology, University of Gothenburg, Sweden.

This thesis is an examination of leadership and creativity in research. Specifically, it studies leadership and creativity in academic research groups and commercial research groups in the biosciences. Leaders in these research settings face similar challenges, in particular the uncertainty that characterizes such creative work. Moreover, because this work is knowledge intensive, leaders in research lead followers who, with their special expertise and skills, have a propensity for work autonomy. Therefore, the essential goal of this thesis is to understand how leaders in research settings can promote creativity among their followers.

The main theory behind this research is leader-member exchange (LMX) theory, which is a relational leadership theory. By using LMX theory, both leaders and followers are included in the study of leadership. According to LMX theory, a leader and a follower form a dyad. The quality of the relationship in that dyad is predictive of an array of desirable work outcomes. Although LMX has previously been associated with work performance, organizational citizenship behaviour, well-being and creativity, in this research the aim was to study LMX in relation to creativity in research settings.

The thesis contains four related studies. Study I is a qualitative study of how followers perceive leaders to have stimulated creativity in research. Study I concludes that leaders can stimulate creativity by providing expertise and support to their followers. Study II, Study III and Study IV are correlational studies. Study II examines work two behaviours – cognitive support and knowledge resources – as antecedents of LMX. Findings indicate that leaders' provision of cognitive support and knowledge resources are two possible ways for leaders to improve leader-follower relationship quality. Study III and Study IV look at the relationship between LMX and a bibliometrical measure of creative performance (numbers of publications), retrospectively (in Study III and Study IV), and prospectively (in Study IV). Study III proposes that leader-ratings of LMX (rather than follower-ratings) are positively associated with creative performance in academic research settings. In its evidence about the differences in creative performance between the two groups, Study III shows that LMX has negative predictive ability in commercial research settings. Study IV argues that the positive association between leader-rated LMX and creative performance in the academic research groups was sustained over the substantial period of three years. Both Study III and Study IV show that leader-ratings of LMX (rather than follower-ratings) influence creative performance. However, only relationships of the highest quality (relationships where both leader and follower agree on the high quality of the relationship) are associated with followers' greater past creative performance (Study IV). This conclusion is consistent with previously untested theoretical assumptions (Elkins & Keller, 2003).

Historically, psychological research on creativity has emphasized individual traits and abilities in a way that might question whether it is possible to lead creative individuals or creative work. However, the claim of this thesis is that leaders can influence creativity in research and can influence followers' perceptions of the leader-follower relationship quality. Moreover, the claim is that leaders' perceptions of the leader-follower relationship quality, rather than followers' perceptions, are important to followers' creative research performance.

Keywords: LMX, leadership, creativity, research groups, R&D

Preface

This thesis is based on the following four papers, which are referred to in the text by their Roman numerals:

I. Hemlin, S., & Olsson, L. (2011). Creativity-stimulating leadership: A critical incident study of leaders' influence on creativity in research groups. *Creativity and Innovation Management, 20 (1),* 49-58.

II. Olsson, L., Denti, L, & Hemlin, S. Leaders' enhancement of leader–member exchange (LMX) relationships: An examination of leaders' cognitive support and knowledge resources in research groups. *Submitted for publication.*

III. Olsson, L., Hemlin, S., & Pousette, A. (2012). A multi-level analysis of leader–member exchange and creative performance in research groups. *Leadership Quarterly, 23,* 604-619.

IV. Olsson, L. Do leaders matter in the long-run? A longitudinal study of the importance of LMX and LMX balance for followers' past and future creative performance in research groups. *To be submitted for publication.*

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Göteborg, 11/15/12

Lisa Olsson

Svensk sammanfattning

Denna sammanläggningsavhandling består av en sammanfattande kappa och fyra delarbeten. Vart och ett av dess delarbeten är utförda i biomedicinska och biotekniska forskningsmiljöer, och berör på olika sätt ledarskap och kreativitet i akademisk och/eller kommersiell forskning. Ledarskapet i dessa miljöer möter liknande utmaningar då kreativt arbete ofta kännetecknas av ovisshet, både för ledare och för medarbetare. Att forskningsarbete är kunskapsintensivt och att forskningsledarens arbete är att leda andra forskare med olika kompetenser är en ytterligare utmaning. Frågeställningen om på vilket sätt ledare kan agera för att verka för kreativitet i forskningsmiljöer var drivande för arbetet med avhandlingen.

Jag ville studera ledarskap och kreativitet genom att ta i ledare och medarbetare i beaktande. Detta är ett avgörande skäl till att avhandlingen baserar sig på en relationell ledarskapsteori, den så kallade ledar-medarbetarutbytesteorin (leader-member exchange [LMX] theory). Enligt LMX teorin utgör varje ledare och medarbetare en dyad. Kvaliteten på den dyadiska relationen mellan en ledare och en medarbetare har visats påverka en mängd faktorer i arbetslivet, som till exempel arbetsprestation, engagemang för organisationen, välmående och kreativitet. Jag ville specifikt undersöka om LMX-kvaliteten kunde relateras till kreativitet i forsknings-miljöer, eftersom detta tidigare studerats i liten utsträckning (Elkins & Keller, 2003).

De fyra delstudierna baserar sig dels på kvalitativ metodik (Studie I), dels på kvantitativ metodik (Studie II, II och IV) för att belysa ledarskap och kreativitet.

I Studie I (n = 93) undersökte vi kreativiteten i akademiska och kommersiella forskar-grupper genom att låta medarbetare erinra sig och beskriva kreativa händelser som ledaren i gruppen initierat. Vi använde en beprövad intervjuteknik kallad Critical Incidents Technique (Flanagan, 1954). Forskare uppmanades att tänka tillbaka på och beskriva tre olika situationer där ledaren specifikt gjort något som stimulerat deras kreativitet. Dessa data analyserades sedan med innehållsanalys och statistiska beräkningar genomfördes för att ta reda på om de akademiska och kommersiella forskarna skiljde sig åt i vilka incidenter som rapporterades. Sammantaget fann vi i Studie I att ledare kunde stimulera medarbetares kreativitet genom att förse medarbetare med expertis och stöd. Akademiska och kommersiella forskargrupper skiljde sig inte åt i vilka ledarbeteenden som uppfattades ha varit kreativitetsstimulerande men rapporterade incidenter tenderade ha ett individfokus bland akademiska forskare, medan incidenter som rörde gruppvillkor framstod som mer betydande för kreativiteten bland kommersiella forskare.

I Studie II (n = 166) föreslog vi att två faktorer som ledare har kontroll över – Kognitivt Stöd och Kunskapsresurser – skulle kunna förbättra LMX-kvaliteten i var och en av LMX sub-dimensioner: Affekt, Lojalitet, Bidrag till Arbetet, och Professionell Respekt. Resultaten från i Studie II indikerade att ledare kan förbättra ledar-medarbetarrelationen (LMX-kvaliteten), sett ur ett medarbetarperspektiv, genom att förse medarbetare med kognitivt stöd och kunskapsresurser. Att ge kognitivt stöd innebär t.ex. att stötta medarbetaren i det kreativa arbetets olika faser av idégenerering och idéimplementering. Att förse en medarbetare med kunskapsresurser innebär t.ex. att se till att medarbetaren har kontakt med de främsta forskarna i fältet.

I Studie III (n = 137) undersökte vi hårda mått på kreativa prestationer genom att mäta ledares och medarbetares publikationsantal. Vi ville ta reda på om ledarskattningar av LMX (SLMX) och medlemsskattingar av LMX (MLMX) kunde knytas till dessa publikationsmått, d.v.s. om det var bra för den kreativa prestationen att ha goda relationer. Resultaten i Studie III visade att LMX delvis kunde relateras till kreativ prestation. Vi fann att det var ledarens syn på LMX-kvaliteten (SLMX) som hade starkast positiv inverkan på ledare och medarbetares kreativa prestation i akademiska forskargrupper. SLMX hade ett positivt samband med ledares egna publikationsantal och medarbetarnas publikationsantal. MLMX hade ingen inverkan på varken ledares eller medarbetares publikationsantal i akademin. SLMX och MLMX hade ett negativt samband med kreativ prestation i de kommersiella forskargrupperna, till skillnad från sambandet i de akademiska forskargrupperna där sambandet var positivt. Detta tolkades som att de två organisatoriska kontexterna värderade publicerandet av vetenskapliga artiklar olika. Detta pekar på att kreativitet är domänspecifikt och på det tydliga behovet av ett anpassat kreativitetsmått.

Studie IV (n = 82) var en longitudinell uppföljning av forskargruppsmedlemmarna ur akademin som deltagit i Studie III. Tre år efter att vi studerat LMX och publikationsantal i Studie III samlade vi in nya publikationssiffror för medarbetare för att undersöka hur effekterna av LMX såg ut över tid. Mått på medarbetares publikationer användes alltså för att mäta medarbetares kreativa prestationer både retrospektivt och prospektivt. I Studie IV visade sig det positiva sambandet mellan SLMX och medarbetares kreativa prestation (Studie III) bestå (eller till och med öka). Medarbetarperspektivet på LMX hade viss betydelse när vi undersökte överensstämmelse i ledar- och medarbetarskattningar av LMX och kreativ: Medarbetare i ledar-medarbetarrelationer av högsta LMX-kvalitet, d.v.s. där ledare och medarbetare var överens om att relationen var god, hade publicerat mer jämfört med andra

typer av relationskvalitet, när det gällde retrospektiva data. Att bara hög-högkvalitativa relationer är kopplat till högre prestation är helt i linje med de teoretiska prediktioner för LMX i forskningsmiljöer som gjorts av Elkins och Keller (2003).

I psykologisk kreativitetsforskning har ofta individuella förmågor och egenskaper framhållits (individens motivation, domän-specifik expertis och kreativ förmåga), på ett sätt som kan ifrågasätta om kreativa individer överhuvudtaget behöver eller kan ledas. Baserat på resultaten i denna avhandling, vill jag dock påstå att ledare har betydelse för kreativitet i forskning. Sammanfattningsvis för alla studierna, pekar resultaten på att ledaren kan påverka medarbetares kreativitet (Studie I) och deras uppfattning om ledar-medarbetarrelationen (Studie II). Vidare konstateras att det främst ledarens syn på ledar-medarbetarrelationskvaliteten snarare än medarbetarens syn, som är relaterad till kreativa prestationer, mätt som ledares (Studie III) eller medarbetares publikationer (Studie III och IV).

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Introduction

All creative achievements originate from the efforts of individuals. However, to view creative performance entirely as an individual achievement is misleading. The success of an individual's creative effort is dependent on many contextual factors. In the work environment, leaders play a potentially important role in directing and coordinating followers' efforts and in elaborating and improving on followers' ideas. This leader behavior produces higher creative achievement for both the individual and the organization.

This thesis concerns leadership in academic research groups and commercial research groups in which followers are expected to be autonomous and motivated, with their own visions of the work. The main questions in this thesis are the following: Which leader actions encourage followers' individual creativity? To what extent are the relationships between leaders and followers important for creativity in research groups? Which aspects of leader-follower relationships are important for creative performance in research? To what extent are leader-follower relationships influencing creative research performance in the long-run?

Science can be defined as the process of developing and testing mental models of how the world works (Feist, 2006). Scientists, who often work in groups, should be viewed as knowledge workers in a network of complex relationships. Scientific work is thus a cognitive activity that occurs in a social context. Therefore, leadership of some sort is a necessity in research. Leadership is a vast area of research that has been studied in various disciplines from a wide array of perspectives. I argue that key psychosocial elements in a research environment are the relationships that develop between leaders and followers. Good rapport between leaders and followers is likely to result in a number of desirable work outcomes (Gerstner & Day, 1997). The relationship that develops between a leader and a follower is a psychological one that is determined by their initial perceptions and expectations of each other, their actions, and their past experiences, as well as contextual and environmental circumstances. Based on this reasoning I have chosen the leader-member exchange (LMX) theory to make up the theoretical foundation of this thesis, to a large extent. LMX theory acknowledges the importance of both leaders and followers in leadership. Therefore, the definition of leadership I use in this thesis is the quality of the relationship that develops between a leader and a follower (Liden & Maslyn, 1998).

Individual researchers can be more or less creative, but scientific research is in itself creative and requires creative performance. Without creativity in science, there will be no

scientific progress, neither incremental progress nor radical progress (Feist, 1998). Even the most incremental scientific contribution should add something new and useful to the already known in order to be adopted in its field. To maintain competitiveness, research group leaders need to make the most of their followers' creative abilities (Shalley & Gilson, 2004).

The four studies in this thesis were conducted in Swedish academic and commercial research groups in the biosciences (i.e., biomedical and biotechnical research groups). Sweden has been influential in biomedical and biotechnical research historically (VINNOVA, 2005). Medicine, the natural sciences, and technology account for about 70% of all the academic research conducted in Sweden (VINNOVA, 2006-2007). Bio-scientific research has also contributed to creative innovations of great social and economic value.

The thesis has two interests: The theoretical interest in how leadership and creativity are related in science, and the societal interest in our knowledge of how leaders facilitate creativity in research groups.

The Academic and Commercial Research Settings

In this thesis, the term research is used to refer to academic research and to commercial research and development (R&D). Academic research groups and commercial research groups, particularly those in the biosciences, merit joint study since they share several characteristics. Groups in both research settings explore the unknown and seek solutions or answers to many ill-defined problems. There is no guarantee that creative efforts by academic or commercial research groups will be successful. This means working, making decisions, and securing funding under uncertainty.

The results achieved by researchers in academic research groups are published in scientific journals. In the biosciences, academic research findings can sometimes also be applied and converted into products in commercial ventures (innovations). Biomedical and biotechnical research is regarded as a field in which science-based knowledge is transformed into innovations perhaps more rapidly than in any other field (Hollingsworth & Hollingsworth, 2000). As the "D" in R&D suggests, the emphasis by commercial research groups is more often on the further development of a research result by converting it into a marketable product.

Since bio-scientific research is costly, there has been an increase in small, commercial research companies that also specialize in conducting early-phase research work similar to the

work of academic researchers. In pharmaceutical development, such small companies generate ideas and perform research up to the point where they sell the concept to a larger pharmaceutical company that has the necessary resources to conduct the final stages of the clinical testing and to launch the pharmaceutical product. This is a win-win situation since the smaller company has the new ideas, flexibility and drive that sometimes the larger company lacks. On the other hand, small companies have limited funding resources to complete and market a tested and approved product.

In comparing scientific exploration in academic and commercial research, the commercial setting features one common solution (decisions are made to reach a final solution to a problem in order to finalize a product) while the academic setting is more likely to feature several plausible solutions to a problem. A commercial research group is under pressure to produce a commercially viable product. Work in academic research groups is less constrained by economic and seldom by commercial factors; therefore, academic researchers are freer to conduct scientific explorations. At the same time, according to current Swedish research policy, academic researchers in Sweden are encouraged to be increasingly entrepreneurial. This development is also evident internationally such as in the growth of governmentally funded technology transfer organizations at universities that are intended to convert academic results into commercial products (Van Looy, Callaert, & Debackere, 2006). Moreover, there has been greater pressure on academic researchers to publish their results in prestigious scientific journals since publications are increasingly a determinative factor in the allocation of research funding. As a result, academic research has become more "product-oriented" than before.

To conclude, there are similarities in academic and commercial research that make the settings worthy of joint study, but there are also important differences in their work. The terms research and R&D are both used in the literature, depending on academic tradition. Both terms are used in this thesis, depending on the literature cited. However, when I refer to our own data, I use the terms research and research groups.

Theoretical Framework

Introduction to the Concept of Creativity

Creativity has repeatedly been defined as the ability to generate ideas that are novel/original and useful/adaptive (Amabile, 1996; Feist, 1998; Hemlin, Allwood, & Martin, 2008; Mumford & Gustafson, 1988; Perkins, 1990; Ward, Smith, & Finke, 1999). As Feist (1998) noted, the requirements of usefulness and adaptiveness are necessary to distinguish creative thought or behavior from the eccentric, schizophrenic, or bizarre. These requirements, however, do not mean that a creative idea must necessarily have concrete, practical use. Ideas can be judged as creative based merely on their intellectual or aesthetic value (Feist, 1998).

Innovation is a concept that has been used interchangeably with creativity in some disciplines (Kahl, da Fonseca, & Witte, 2009). Scholars have been criticized for not delineating clearly between the two. The concept of innovation expands the definition of creativity by its inclusion of the implementation or even commercialization of an idea (e.g., Björk, 2011). In the tradition of the psychology of science (Feist, 2006; Feist & Gorman, 1998), scholars commonly use the creativity concept, while management researchers appear to prefer the term innovation. This reflects different interests in different phases of the creativity and innovation processes: psychologists focus on the idea generation phases and management researchers focus on the implementation phases. However, the differences are not clear-cut between creativity and innovation in research (Denti & Hemlin, 2012a, b).

Leading Creative Work

Leadership in creative work differs from leadership in less creative work because of the characteristics of creative workers and the nature of creative work (Mumford, Scott, Gaddis, & Strange, 2002). Creative people have expertise and high achievement motivation, and a strong need for independence. Therefore, leaders of creative people should provide their subordinates with intellectual stimulation and the freedom to explore, as well as protect them from task-unrelated work. Moreover, creative work is an uncertain venture, and its leadership cannot rely on routine action plans. Mumford et al. (2002) therefore recommend an integrative leadership style that coordinates expertise, people, and relationships in the different phases of creative work.

A number of factors at the individual, group, and organizational levels affect individuals' creativity. At the individual level, task-motivation, domain-specific expertise, and creative skills (Amabile, 1996) are essential for creative performance. First, intrinsic task-motivation is argued to be more conducive to creativity than extrinsic task-motivation. However, extrinsic motivators, such as rewards, can be conducive to creativity as long as they aim to increase an individual's intrinsic motivation (for instance, rewards that inspire advances in work) rather than focus on an individual's extrinsic motivation (Amabile, 1996). Second, creative people tend to invest in expertise. Domain-specific expertise is an important asset for both leaders and followers (Mumford et al., 2002). Third, regarding creative skills, studies conducted in experimental settings suggest that leaders of creative people require cognitive problem solving skills (Mumford, Connelly, & Gaddis, 2003) and creative thinking skills (Jaussi & Dionne, 2003) if they are to evaluate and improve on subordinates' creative ideas.

It is preferable that leaders and followers who engage in creative work possess all these of three abilities. Empirical findings have shown that leaders, using role-play, can assume unconventional behaviors intended to increase follower creativity (Jaussi & Dionne, 2003). Moreover, follower creativity may be enhanced merely by clearly stating that creativity is an expected objective. In their examination of leaders' support for creativity among followers, Tierney and Farmer (2004) found that followers' perceptions of support correlated with leaders' expectations of creativity.

Creative people have been found to differ from less creative people on a number of personality traits as measured by psychometric, validated scales. In a meta-analytic review, Feist (1998) compared scientists to non-scientists (k = 26 studies, N = 4852), creative scientists to less creative scientists (k = 28 studies, N = 3918), and artists to non-artists (k = 29 studies, N = 4397) based on the previous research that examined personality traits and creativity. Feist concluded that creative people are typically more open, conscientious, self-accepting, hostile, and impulsive than non-creative people. With respect to scientists, Feist (1998) also found that less creative scientists are typically more conscientious, more conventional and less open-minded than creative scientists.

At the group level, numerous environmental factors are said to influence individual and group creativity. A leader exerts direct or indirect influence over many of the variables suggested to influence creativity, such as, group climate, group composition, resources, and knowledge management, (Hemlin et al., 2008). In a recent meta-analysis on team-level

predictors of individual and group creativity and innovation in the workplace, it was also found that external communication ($r_{corrected}$ = 0.418), internal communication ($r_{corrected}$ = 0.369), cohesion ($r_{corrected}$ = 0.331) and support for innovation ($r_{corrected}$ = 0.261) were the variables most strongly related to individual creativity (Hülsheger, Anderson, & Salgado, 2009). In a rather pessimistic view of leadership, Krause (2004) speculated on whether leaders are, at best, non-hindrances to creativity. She stated that leaders are perhaps well advised to leave their creative followers alone and instead focus on protecting them from organizational demands and mundane tasks. According to a review of empirical studies from the last 30 years, leaders have consistently been found to influence creativity and innovation (Denti & Hemlin, 2012a, b). I can therefore conclude that there is agreement that leadership is vital to work place creativity. Although it can be argued that creativity is unpredictable, and cannot be managed in a strict sense, leaders can manage the conditions for creativity (Amabile & Gryskiewicz, 1987; Hemlin, 2006).

Leading Research

The individual expertise of leaders and followers is at the core of any creative activity. In research, leaders need expertise in one or more domains if they are to solve scientific problems and coordinate the high level of required competence among followers (e.g., Amabile, 1996; Mumford et al., 2002). In teams and organizations leadership is a necessity. In a study conducted in a Swedish industrial R&D setting, Denti and Hemlin (2012a) have argued that leadership is a "hygienic factor". In their interpretation, as long as leader-follower relationships are good enough, such relationships at least have no negative effect on followers' innovativeness. It appears, research group leadership can, at best, be conducive to creativity, but, at worst, be detrimental to creativity.

In the large body of leadership literature, only a few studies have treated leadership in research environments (Elkins & Keller, 2003). Apart from expertise, research group leaders need the ability to support and encourage individuals and groups (Elkins & Keller, 2003; Mumford et al., 2002). Elkins and Keller suggested transformational leadership is conducive to creativity in a research setting. Moreover, they suggested that followers' satisfaction and performance in research settings – compared to development settings where tasks are usually more structured and less varied – depend more on leaders' consideration toward group members whose research work is more ill-defined and thus more uncertain. In a study on

well-educated knowledge workers in three industries (chemical, high tech, and consumer products), the perceived support from the group leader was important to group member creativity. Knowledge workers who perceived their leaders as supportive of them and their work were more likely to be rated creative by their peers. Supportive leaders monitored progress efficiently and fairly, consulted with group members on important decisions, gave emotional support to group members, and recognized their good performance (Amabile, Schatzel, Moneta, & Kramer, 2004).

While a leader's social skills, such as showing support, are important for the successful leadership of a research group, these skills are also important for making and maintaining relations with useful contacts outside the group. No matter the level of expertise in the research group, the leader's ability to make and maintain relations with an external network of relevant experts (as well as encourage followers to do the same) is likely to be fruitful to creativity. It is recommended that effective research leaders actively interact with external contacts at the same time as they lead the group internally (Elkins & Keller, 2003). External experts in the field (or in related academic disciplines or commercial areas) can provide new knowledge and valuable perspectives that shed new light on research problems, spur new areas of research, and act as contacts into other networks (e.g., Burt, 2004).

In settings in which followers' expertise and motivation are as evident as they are in research groups, it may be inappropriate to place an excessive emphasis on the role of the leader. In some respects, researchers lead themselves ("self-management") because they have their own visions, manage their own research tasks and take active leadership roles in giving and receiving criticism (Hemlin, 2006).

Followers' individual efforts are thus crucial for creative work outcomes. Without follower efforts, there are no creative achievements. And without followers there is, of course, no leadership. This does not mean that leaders are unimportant in research. If research efforts are to succeed, it is often required that the research combines deep expertise from several related or different knowledge domains. This may require research group leadership to be more inclusive of followers' ideas and perspectives than leadership in other settings. Therefore, the role of leadership in the research setting may differ from the role of leadership in less knowledge intensive settings.

LMX

In this thesis, leadership is based on LMX theory. In LMX theory, a leader and a follower are referred to as a *dyad,* and LMX is defined as the quality of the dyadic relationship between a leader and a follower (Liden & Maslyn, 1998). The leader-follower dyad is in explicit focus in LMX since leaders are expected to develop unique dyadic relationships with all followers in their workgroups (Graen & Uhl-Bien, 1995).

The study of leader-follower relationships has a long tradition in leadership research. The history of LMX began with the Vertical Dyad Linkage model (e.g., Dansereau, Graen, & Haga, 1975) that has since evolved into the LMX theory of today. In the early years of the research, role theory was central to LMX theory development (e.g., Dienesch & Liden, 1986). Later, social exchange theory became influential (e.g., Blau, 1964; Cropanzano & Mitchell, 2005; Wayne, Shore, & Liden, 1997). Early LMX work dealt with the development and negotiation of leaders' and followers' roles (Dienesch & Liden, 1986). Antecedents, correlates, and outcomes of LMX were investigated (e.g., Gerstner & Day, 1997). In more recent years, scholars have begun to address LMX differentiation (Liden, Erdogan, Wayne, & Sparrowe, 2006), the lack of leader-follower agreement in LMX ratings (Cogliser, Schriesheim, Scandura, & Gardner, 2009; Markham, Yammarino, Murry, & Palanski, 2010) and the multi-leveled nature of LMX (i.e., recognizing that individuals are dependently nested in dyads, in groups, and in organizations). See, for example, Yammarino, Dionne, Chun, and Dansereau, 2005.

To investigate how dyadic LMX relationships are formed, scholars have studied early LMX development using longitudinal timeframes of up to 6 months. It appears that LMX relationships establish quickly and then stabilize. In their study of newly formed dyads, Liden, Wayne and Stilwell (1993) found leaders' and followers' initial expectations of each other predicted their respective LMX ratings two, six, and 24 weeks later. Early LMX development may therefore be crucial to subsequent relationship development (Liden et al., 1993). In another study of new dyads in a university student setting, both leader and follower ratings of LMX increased between week one and week four, and stabilized between week four and week eight. In the eight weeks of this study, leader and follower agreement in ratings of LMX increased (Nahrgang, Morgeson, & Illies, 2009).

The quality of leaders' and followers' dyadic exchanges has been associated with a number of positive work outcomes at the individual, group, and organizational levels. These

work outcomes include work performance, employee wellbeing and satisfaction, and organizational commitment (Gerstner & Day, 1997). In R&D, no less-than-high-quality relationships have been suggested as contributors to project effectiveness (Elkins & Keller, 2003).

The exchange.

Leader-member exchanges can be seen as resources, ranging from the particular to the universal, and from the abstract to the concrete (Wilson, Sin, & Conlon, 2010). When one party in a dyad offers a resource, it is suggested that the offer will be reciprocated with the same kind of resource. When such a like exchange is impossible (for instance, followers cannot offer leaders a salary raise), other resources can be offered in exchange (for instance, followers can reciprocate a salary raise with information from colleagues) (Wilson et al., 2010). Exchanges may include leaders' offer of work latitude and influence in decision-making, leaders' enhancement of communications, support, confidence, and consideration (i.e., LMX-7, Scandura & Graen, 1984), and leader-follower mutual exchanges of affect, loyalty, contribution, and professional respect (i.e., LMX-MDM, Liden & Maslyn, 1998).

Measuring LMX: From confusion to relative consensus.

There has been a fair amount of confusion about the content of leader-member exchanges. Schriesheim et al. (1999) provide an impressive overview of the wide variety of LMX measures and LMX constructs that have been used in LMX theory since its conception. In 1999, when there was virtually no consensus on what the LMX construct measured, numerous invalidated measures were used. Schriesheim and colleagues identified a number of LMX measures, consisting of 2 to 40 items. The LMX construct was most frequently defined as "quality of exchange" or "quality of relationship," but the definitions "role-making" and "negotiating latitude" were also used (to mention only a few). These inconsistencies in theory and measurement, along with inconsistencies in levels of analysis in many studies (Yammarino et al., 2005) made comparisons among studies difficult, if not impossible, and led only to limited progress in the field (Schriesheim et al., 1999). Since 2000, most researchers now use one of two LMX measures: the uni-dimensional measure LMX-7 created by Scandura and Graen (1984) (81%) or the LMX multi-dimensional measure LMX-MDM (19%) created by Liden and Maslyn (1998) (Joseph, Newman, and Sin (2011). Although most researchers have used only follower-rated LMX (MLMX [M = Member]), a number of researchers also use leader-rated LMX (SLMX [S = Supervisor]) (Schyns & Day, 2010).

Multi-dimensional leader-member exchange relationships.

The LMX measure used in this thesis was the multi-dimensional measure of LMX (LMX-MDM) (Liden & Maslyn, 1998). Followers and leaders rated LMX individually. The followers used the LMX multi-dimensional measure (LMX-MDM) developed by Liden and Maslyn (1998). This measure assesses a global score for the exchange as well as for the four sub-dimensions of Affect, Loyalty, Contribution, and Professional Respect. The leaders used a parallel leader version – the supervisor LMX multi-dimensional measure (SLMX-MDM) developed by Greguras and Ford (2006) – and rated each of their participating followers. Both LMX-MDM and SLMX-MDM consist of twelve items each, with a seven-point response format (where higher scores represent higher quality exchanges). For both followers and leaders, Affect measures the respondent's liking for the other dyad party (e.g., "My supervisor/subordinate is a lot of fun to work with"). Loyalty measures the degree of loyalty the respondent feels from the other dyad party (e.g., "My supervisor/subordinate would defend me to others in the organization if I made an honest mistake"). Contribution measures the amount of the respondent's own efforts exhibited in achieving work goals (e.g., "I am willing to apply extra efforts, beyond those normally required, to meet my supervisors' work goals/to help my subordinate meet his/her work goals"). Finally, Professional Respect measures the respondent's professional esteem for the other dyad party (e.g., "I admire my supervisor's/subordinate's professional skills"). It is arguable that Affect and Loyalty measure the more social aspects of the leader-follower relationship, while Contribution and Professional Respect are more task-oriented. The task-oriented sub-dimensions may be particularly important in a knowledge intensive setting. For a detailed description of LMX-MDM and SLMX-MDM items, see Appendices 1 and 2.

LMX findings.

The LMX relationship that develops in a dyad is assumed to predict a number of desired outcomes for individuals, their workgroup, and their organization. In Gerstner and Day's (1997) meta-analysis, the quality of leader-follower relationships has been associated with an array of positive workplace outcomes, such as work performance, employee satisfaction and wellbeing, and organizational commitment. More recent empirical works have also associated LMX with work performance (Burton, Sablynski, & Sekiguchi, 2008; Wang, Law, & Chen, 2008), employee satisfaction and wellbeing (Hooper & Martin, 2008; Sherony & Green, 2002), and organizational citizenship behavior (Burton et al., 2008; Illies, Nahrgang, & Morgeson, 2007; Wang, Law, Hackett, Wang, & Chen, 2005).

With respect to work place creativity, MLMX has been associated with different measures of creative performance, such as invention disclosure forms (Tierney, Farmer, & Graen, 1999), and leader ratings of innovative behavior or creativity (Scott & Bruce, 1994; Tierney et al., 1999). Moreover, MLMX has an indirect effect on creativity via self-efficacy (Liao, Liu, & Loi, 2010 [LMX-7; Graen & Uhl-Bien, 1995]), on innovation via personal initiative (Denti & Hemlin, 2012c [LMX-MDM-12; Liden & Maslyn, 1998]), and on creative work involvement via feelings of energy (Atwater & Carmeli, 2009 [LMX-MDM-11; Liden & Maslyn, 1998]).

The relationship that develops in a dyad is suggested to predict both leader and follower outcomes (Graen & Uhl-Bien, 1995) although followers' consequences of LMX are far more investigated than those of leaders (for exceptions, see Nahrgang et al., 2009; Wilson et al., 2010).

Recent tendencies in LMX research.

There are dyadic relationships in workgroups besides the leader-follower groups. Follower-follower relationships (e.g., coworker exchange [CWX], Sherony & Green, 2002) are potentially influential on work place outcomes. Additionally, both leaders and followers have professional relationships with individuals who are external to the workgroup. Social network studies on innovation address relationship networks — internal or external to workgroups and organizations — and their influence on work performance (e.g., Obstfeldt, 2005; Tortoriello & Krackhardt, 2010). Some LMX scholars have recently begun to apply social network perspectives to LMX (e.g., Goodwin, Bowler, & Whittington, 2009; Venkataramani, Green, & Schleicher, 2010) in response to the call from Graen and Uhl-Bien (2005). However, such perspectives are beyond the scope of this thesis.

There is also an increased attention on dyads nested in groups and organizations including an ongoing debate on whether such dyads are independent of one another (Schyns & Day, 2010).

These observations highlight three timely issues in LMX theory: LMX agreement, LMX consensus (Schyns & Day, 2010), and levels of analysis (Yammarino & Dansereau, 2008; Yammarino et al., 2005). I look more closely into these topics in this thesis because LMX agreement and LMX consensus, which relate to the important issue of levels of analysis, have consequences for the practical application of LMX theory.

The Dyad: LMX agreement.

The leader-follower dyad is an explicit focus in LMX theory. For a proper examination of LMX, it is recommended measuring the exchange from both leader and follower perspectives. Yet scholars have mostly measured LMX by taking only the follower perspective (Gerstner & Day, 1997). LMX agreement refers to the extent to which leader and follower ratings of LMX are intercorrelated (Gerstner & Day, 1997; Schyns & Day, 2010; Sin, Nahrgang, & Morgeson, 2009). One may expect this correlation to be high, but the LMX agreement has generally been fairly low when leaders and followers have assessed the quality of their mutual relationship. Two meta-analyses estimated the true score correlation to be $r_{corrected}$ =.37 (r = .29, k = 24, N = 3460, Gerstner & Day, 1997), and $r_{corrected}$ =.37 (r = .32, k = 64, N = 10884, Sin et al., 2009). The relatively low LMX agreement is a surprising result when using a theory that emphasizes dyadic exchanges and predicts that high agreements are associated with better outcomes (Gerstner & Day, 1997).

To overcome the lack of LMX agreement, scholars have studied LMX balance and compared leader-follower high quality balanced relationships to low quality balanced relationships and to imbalanced relationships. Cogliser et al. (2009) hypothesized that dyads in which leaders and followers agreed on high or low relationship quality would perform best or worst at work, respectively. Furthermore, they hypothesized that follower underestimation of the relationship quality vis-à-vis leader ratings would lead to better follower performance than follower overestimation of such quality. Their findings showed that followers in balanced, high quality relationship and followers who underestimated relationship quality in relation to their leaders outperformed followers who overestimated the relationship or had balanced, low relationship quality. In their study, Markham et al. (2010) showed that the relationship between LMX and performance was stronger in balanced relationships (r = .72, p <.01) than in imbalanced LMX relationships (r = .37, p < .05).

The Group: LMX consensus or LMX differentiation.

LMX consensus (also referred to as LMX differentiation, see Liden et al., 2006) is the extent to which followers in workgroups vary in how they view the quality of their relationships with their leader (Schyns & Day, 2010). Generally, many leader-follower dyads exist in a workgroup. Theoretically, the quality of the relationships is expected to differ for different leader-follower dyads in groups. It is a theoretical tenet in LMX theory that leaders develop different relationships with their various followers (Dansereau et al., 1975).

I argue that overall relationship quality in groups can influence individual creative performance. Studies on LMX and creativity indicate that low LMX differentiation is beneficial for creativity. In a study of 144 followers in a German high-technology firm, Volmer, Spurk, and Niessen (2012) found that LMX differentiation moderates the LMX-creativity relationship (creativity measured as followers' creative work involvement). In the same vein, in a study in a Chinese company, Liao et al. (2010) found LMX differentiation moderates the relationship between LMX and self-efficacy. Self-efficacy was related to followers' creativity (measured as creativity bonuses awarded by an evaluation committee in the HR department). Both studies indicated that LMX differentiation had a negative influence on creativity. In conclusion, it seems that the quality of exchanges in groups affects individual creative performance.

Empirically, the idea of LMX differentiation means that relationship quality in groups is a zero-sum game. The assumption that relationships differ in groups means that high quality relationships occur at the expense of other group relationships. However, this assumption may be questioned for several reasons.

First, it can be argued that phenomena in groups tend to strengthen when they are shared. Tindale and Kameda (2000) describe work groups as information-processing units and introduced the concept *social sharedness* as a way to describe that things "that are shared to a greater degree within groups will have greater influence on the relevant group outcomes/responses than those things shared to lesser degrees" (p. 124). Social sharedness may also be applied to research groups. Social sharedness is understood to encompass a broad range of things that can be shared among group members including identities, preferences, attitudes, motives, norms, cognitions, and cognitive processes. In a research group, such social sharedness means, for instance, that the work attitudes strongly shared by group members influence their work and work relationships, both positively and negatively, more than the work attitudes they share less. This is why it is beneficial for a follower to be part of a group in which the scientific debate is generally lively and permissive and the work ethic is high rather than in a group in which the scientific debate is more muted and belief in the work ethic is low or less pronounced.

Second, the relationship quality in a group may influence the relationship quality of the unique dyads. High quality relationships can promote a positive tone in other relationships in a group. Sherony and Green (2002) investigated follower-follower dyadic relationships using coworker exchange (CWX) among 109 US employees in an engineering company and in a

health service facility. They found that followers who had similar LMX relationships with their shared leader also had more positive CWX relationships. CWX may therefore serve as a multiplier of LMX if a follower with high quality LMX and strong high quality CWX relationships in a group can spread more positive LMX relationships. Strong, negative CWX relationships then have the opposite effect. It is therefore suggested that leaders should try to develop positive leader-follower and follower-follower relationships (Sherony & Green, 2002).

The theoretical assumption in LMX theory is that relationships in groups differ. Yet the recommendation for encouraging positive work outcomes is that leaders should not differentiate among their followers (Schyns & Day, 2010). It has been suggested (although not empirically supported) that leaders can differentiate among their followers without harming performance as long as their followers perceive the differentiation as fairly based on the contribution each follower makes (Liden et al., 2006). LMX differentiation may only have a negative impact on individual performance if the differentiation is perceived as unfair. Instead of differentiating, it has been recommended that 1) leaders strive to develop high quality relationships with their followers, 2) leaders and followers agree on the high quality of the relationship, and 3) leaders develop high quality agreement relationships with all followers in their workgroups. These desirable conditions – high level, high leader-follower agreement, and high within-group consensus – are referred to as LMX excellence (Schyns & Day, 2010).

In sum, I acknowledge that LMX relationships are dyadic, but argue that their quality is affected by their context. In other words, it is beneficial to work in groups where relationships overall are positive.

The Importance of Levels of Analysis

Leadership is multi-leveled in nature. In the past, most studies of leadership have disregarded levels of analysis. According to a state-of-the-science-review of the last decade of leadership literature, conceptual and empirical papers rarely address multi-level issues (Yammarino et al., 2005). Scholars agree that LMX should be studied with respect to levels of analysis using multi-leveled approaches because the participants who provide the data are nested in workgroups and thus are not independent of each other. This violates the assumption of independent observations in statistical inference testing. Participants who are nested in groups

and organizations share a unique context. This unique context may influence the relationship between two variables so that the relationship between the variables differs in different groups. Integrative studies of variables at individual, group, and organizational levels in joint studies require that particular attention be paid to levels of analysis since the theoretical levels of variables have implications for measurement, analysis, and inferences (Yammarino et al., 2005; Schriesheim et al., 1999).

There are several levels to consider in studying leadership, depending on the area of interest: individuals (independent individuals), dyads (two-person entities: leader-follower, follower-follower, or leader-leader), groups (workgroups or teams of followers with a shared leader), and organizations (groups of groups, such as companies and faculties). A variable at one level may influence another variable at the same level of analysis. The variable may also influence variables at *other* levels of analysis, and this influence may differ at the different levels. For instance, in LMX it is of interest whether the positive consequences of a high quality dyadic exchange with one's leader are immune to the relationship quality that other followers have with that same leader. Dyadic LMX and LMX at the group level may not affect individual performance in the same way. There have been radical scientific discoveries when scientific theory included other levels of analysis (Yammarino et al., 2005). For instance, the theory of evolution was proposed only after examining levels of analysis higher than the organism level; research in quantum mechanics was possible only when levels of analysis lower than the atomic level were considered. Therefore, it is important to specify the level under consideration for a construct in order to examine its effect. It is possible that leadership at the dyadic level affects individual creativity differently than it affects group creativity. Schriesheim, Castro, Zhou, and Yammarino write: (2001):

> [I]t is absolutely critical that scholars specify the level of analysis at which their hypotheses, frameworks, models, and/or theories hold so that they may be adequately tested. We also believe that it is absolutely necessary that tests of any hypothesis, framework, model, and/or theory be conducted at the proper level(s) of analysis and that tests explicitly rule out inappropriate or competing (rival) levels of analysis. Otherwise, Type I or II errors may occur (i.e., improperly rejecting or not rejecting a particular null hypothesis) and we may wind up erecting theoretical skyscrapers on foundations of empirical jello. (p. 516)

Consistent with the LMX tradition, I recognize LMX as a dyadic level construct. Several empirical studies using multi-level techniques support this idea (Markham et al., 2010; Schriesheim et al., 2001; Schriesheim, Neider, & Scandura, 1998). A few researchers have identified both dyadic and group level effects (Cogliser & Schriesheim, 2000; Hofmann, Morgeson, & Gerras, 2003; Schriesheim, Castro, & Yammarino, 2000). Markham et al.'s (2010) findings strongly suggest that the relationship between LMX and performance operates at the dyadic level. Therefore, we assume LMX is a dyadic level construct.

Creativity

Brief history of creativity in context.

There are many different approaches to the study of creativity, each associated with its own creative focus, methods, and means of analysis. Most approaches are based in the creative process, person, or product. In a history of creativity studies, Sternberg and Lubart (1999) identified six approaches used more or less successfully in making advances in creativity: the mystical, the pragmatic, the psychodynamic, the psychometric, the cognitive, and the social-personality. They also stated that creativity merits study that incorporates multiple disciplines and perspectives. There is a risk in too strict a devotion to one approach or too narrow a focus on an isolated aspect of creativity. The risk is that other approaches or other loci of focus may be overlooked with the result that central aspects and complexities of creativity may be missed.

Over the years, models of creativity have increasingly integrated different perspectives on and aspects of creativity. The inclusion of multiple individual and contextual factors that influence creativity in models reflects and acknowledges that creativity is a complex phenomenon. Amabile was the first researcher to describe a contextual approach to creativity with her componential model of creativity developed in the early 1980s; several scholars have since proposed other integrative models or approaches to creativity (Csikszentmihalyi, 1999; Harrington, 1990; Hemlin et al., 2008; Mumford et al., 2002; Woodman, Sawyer, & Griffin, 1993). Harrington (1990) called for a more integrative study of the personal and environmental factors that affect creativity. Basing their research in interactional psychology, in their model of organizational creativity, Woodman et al. (1993) integrated the creative process, product, person, and situation as well as the multi-level structure of organizational creativity (individual, group, and organization, including cross-

level interactions). Csikszentmihalyi (1999) embraced a systemic integrative approach to the study of creativity. Along similar lines of thought, Hemlin et al. (2008) proposed incorporating the attributes of a Creative Knowledge Environment (CKE) at the micro-, meso- and macro-levels in the understanding of individual, group, organizational and inter-organizational creativity. In sum, these integrative approaches suggest that creativity should be studied from multiple perspectives by integrating multiple disciplines and multiple levels of organization (individual, group, organization) and by studying creative individuals in their social context of work rather than in isolation.

Studies of creativity appeared as early as the late nineteenth century. Among the early contributors to the field were Sir Francis Galton, Henri Poincaré, and Alfred Binet (Plucker & Renzulli, 1999). It is often claimed that the more formal launch of the field of creativity research occurred in 1950 when J. P. Guilford devoted his American Psychological Association (APA)[1] presidential address to creativity. Since then, interest in creativity has steadily increased, and many approaches to creativity studies have developed. In about the last 40 to 50 years, creativity has been defined as the ability to generate ideas that are novel or original as well as useful or adaptive (Amabile, 1996; Feist, 1998; Hemlin et al., 2008; Mumford & Gustafson, 1988; Perkins, 1990; Ward et al., 1999).

Moreover, there is a general consensus among observers on when creativity is encountered (Amabile, 1996). Audience, timing/zeitgeist, and deliberate effort are factors involved in defining creativity. Many scholars include the response that an idea elicits in others in their definition of creativity (Bruner, 1962, referred to in Amabile, 1996, p. 21). Csikszentmihalyi (1999) argues creativity is "a process that can be observed only at the intersection where individuals, domains and fields interact" and is constructed in "interaction between producer and audience" (p. 314). Harrington (1990) claims that any creativity definition worthy of scientific study must include the social impact of a creative product. This means that creative value is constructed. This constructed value is an important part of the creativity concept (Harrington, 1999).

Gruber and Wallace (1999) identify one element in defining creativity that may apply in particular to research. Even it has been that scientific disclosures are stochastic (Simonton, 2004), there is agreement with Gruber and Wallace who claim that creativity is only conceived through work executed with a deliberate purpose, for an extended period of time.

[1] APA is a scientific and professional organization that represents psychologists in the United States and sets the standard for practice for psychology scholars all over the world.

By including purpose in their definition of creativity, they claim that creative work is not accidental, even if some discoveries may seem serendipitous. Chance favors the prepared mind.

Despite the relative consensus in defining creativity, creativity is difficult to study. The problem is not the definition of creativity, but rather its operationalization. Creativity can be operationalized in many different ways, depending on context. Operationalization of creativity is context-sensitive and domain-specific. Therefore, creativity requires investigation within its specific domains (Amabile, 1996; Ludwig, 1995). What is considered creative in one domain, field, time, or place is not necessarily creative elsewhere. The individual's domain-relevant skills, creativity-relevant skills, and task motivation are basic components in creative performance (Amabile, 1996). In creative research, such skills are necessary both for invention and for evaluation. Because a creation is always creative in relation to and in contrast with something else, expertise and knowledge of one's creative field is crucial for creative achievement.

It is argued that previous experience, knowledge and skills have both enabling and inhibiting influences on creativity (Ward et al., 1999). Prior knowledge can actualize a "functional fixedness" (Ward et al., 1999; Woodman et al., 1993). For professional creative performance in a knowledge intensive environment, however, expertise is undoubtedly needed (Mumford et al., 2002; Perkins, 1990; Woodman et al., 1993). Apart from expertise in one's own field it is also valuable to be knowledgeable in other fields. In a classic study, Kasperson (1978) found that creative scientists accessed information from a broader range of disciplinary areas than their non-productive and non-creative peers. Sometimes creativity is simply applying a well-known idea from one field in a new context. As Burt (2004, p. 389) explains: "The certain path to feeling creative is to find a constituency more ignorant than you and poised to benefit from your idea".

Creativity in research.

Creativity in research can be studied from an evolutionary approach, a cross-disciplinary approach, a social system approach, or a social network approach (Chen & Kaufmann, 2008). The evolutionary approach focuses on idea generation and idea selection. The cross-disciplinary approach addresses creativity with respect to different backgrounds, experiences, skills, knowledge bases, and cultures. The social system approach views creativity as a systemic rather than an individual phenomenon. Therefore, interactions among individual, team/group, and organizational levels (or persons, domains, and fields) are taken into account

in the study of creativity. Finally, the social network approach focuses on interpersonal exchanges and considers interactions as the core of creative activity (Chen & Kaufmann, 2008). LMX and creativity studies as in this thesis take the social network approach.

In the research on creativity measurement, scholars use different creative operationalizations and different creativity indicators in their empirical studies. In the workplace, creativity is frequently operationalized as an outcome of a (creative) work process or of (creative) problem solving: hence, as a creative product (Amabile, 1996). Possible creativity measurement instruments in academic and commercial research groups are invention disclosure forms, registered patents, publications in scientific journals, citations and the h-index. The h-index is a citation index that balances citations against the number of publications a scientist produces. "A scientist has index h if h of his or her Np papers have at least h citations each and the other (Np – h) papers have fewer than < h citations each"; see Bornmann and Daniel, 2007, p. 1381, citing Hirsch, 2005, p. 16569. This means that a scientist who has h-index of 20 has published 20 papers, each with at least 20 citations.

Two classic works on creativity use numbers of publications to assess scientific creativity (Kasperson, 1978; Pelz & Andrews, 1966). Patents have also been used to measure creative performance in industrial settings (Jung, Wu, & Chow, 2008). Moreover, patenting by academic researchers does not interfere with their publishing in academic research groups. Rather, the academic researchers who obtain patents also publish the most scientific articles (Van Looy et al., 2006). In addition, both academic and commercial research groups publish scientific papers (Berends, van der Bij, Debackere, & Weggeman, 2006).

There is, however, criticism that publications, patents and citations measure research productivity rather than creativity. In the "hard" disciplines, such as the biomedical and biotechnological fields that are studied in this thesis, the consensus on what is considered a substantial scientific contribution to the field is greater than in the "soft" sciences (Simonton, 2006). Thus, a creative product from one of the hard disciplines is more likely to be patented than a less creative product; a publication (peer-reviewed and published in an acknowledged scientific journal, e.g. included in the Thomson Reuter databases in "Web of science") from one of the hard disciplines is more likely to be published and cited than a less creative publication. In line with this, publications, patents and h-index can be viewed as suitable indicators of creativity in the research settings of this thesis.

Creativity in research can also be measured using subjective criteria. Groups of independent expert judges can make valid creativity assessments based on clearly defined

subjective criteria (Consensual Assessment Technique (CAT), Amabile, 1996). Other subjective measures of creativity used are self-ratings or supervisor-ratings of creativity. Ratings of creative group climate can serve as proxies of creativity (e.g., KEYS, Amabile, 1996; the Team Climate Inventory (TCI), Anderson & West, 1998; the Creativity Climate Questionnaire (CCQ), Ekvall, 1996). When subjective ratings of creativity are used with subjectively rated independent variables, the relationship may be inflated due to common method variance. Therefore, when possible, it is recommended that independent and dependent variables be obtained from different sources (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

LMX and Creativity in Research

According to Elkins and Keller (2003), leadership in research settings is understudied. LMX is particularly interesting in these settings where followers have a high level of expertise, favor work autonomy (e.g., Feist, 1998; Feist & Gorman, 1998; Amabile & Gryskiewicz, 1987), and are task-oriented (Amabile & Gryskiewicz, 1987). This may require a leadership that is more sensitive to assessing, promoting, and adopting followers' ideas and perspectives. LMX theory was one of the first theories to incorporate followers in the construction of leadership, and may therefore be particularly applicable to the research setting.

Some studies have examined uni-dimensional LMX in relation to creativity (Atwater & Carmeli, 2007; Van Dyne, Jehn, & Cummings, 2002) and to creativity in the research setting (Liao et al., 2010; Scott & Bruce, 1994; Tierney et al., 1999). Other studies have examined the multi-dimensionality of LMX-MDM, (Greguras & Ford, 2006; Harris, Harris, & Harvey, 2008; Law, Wang, & Hui, 2008; Lee, 2005; Lee, 2008; Liden & Maslyn, 1998; Wang et al., 2008), but only Lee (2008) has studied the multi-dimensionality of LMX-MDM in relation to creative performance in research. Lee's (2008) study examined how the follower-rated LMX-MDM sub-dimensions relate to innovative behavior (measured as Kirton's Adaptive Innovation Inventory [KAI]) in a sample of 220 employees from different organizations involved in R&D in Singapore. Lee found that the LMX-MDM sub-dimension Loyalty (although not Contribution) could predict employee creativity. This means that followers with loyal leaders rated themselves as more innovative while followers who were willing to work hard, somewhat surprisingly, did not. It is plausible that the different sub-dimensions of LMX-MDM (Affect, Loyalty, Contribution, and Professional Respect) have

unique predictive value for creativity in research. Contribution is a sub-dimension closely related to organizational citizenship behavior (Joseph et al., 2011) and appears to have particular importance in a knowledge intensive setting (Liden & Maslyn, 1998).

There are also a few studies on uni-dimensional LMX and creativity in academic or commercial research. In a study of 191 R&D workers in a large US chemical company, it was found that the influence of LMX on creative performance differed, depending on whether the follower had an innovative cognitive style (Tierney et al., 1999). LMX was found to positively influence creative performance among those with a less innovative cognitive style (as measured by KAI). The creativity of people with an innovative cognitive style was found to be less dependent on LMX. In this study, creativity was measured as publications, patents and leader ratings of follower creativity.

Scott and Bruce (1994) conducted a survey study of 189 engineers, researchers, and technicians in R&D in a large US chemical corporation. They tested a hypothesized path model of individual innovative behavior that included follower-rated LMX, leader expectations of innovative behavior, relations in the workgroup, and innovative behavior (intuitive vs. systematic). They found LMX quality (and leader expectations of innovative behavior) was directly and positively related to followers' innovative behavior. Innovative behavior was measured subjectively by the leader and by the number of patents.

In a study of 166 dyads in 43 R&D teams in Sweden, follower-rated LMX was not found to have a direct effect on followers' individual innovation (measured as an index of patents, new products, scientific publications, and other publications). Instead, the relationship between LMX and innovation was mediated by followers' personal initiative (Denti & Hemlin, 2012c [uni-dimensional LMX-MDM-12; Liden & Maslyn, 1998]). Personal initiative measures the extent to which a follower acts outside the requirements of the formal work contract and proactively engages in long-term, goal-oriented behaviors. Surprisingly, the same pattern was not found when followers' intrinsic motivation was used as a mediator.

In a longitudinal study on creativity in R&D, LMX differentiation was investigated in relation to LMX quality, self-efficacy, and creativity (Liao et al., 2010, LMX-7). The sample consisted of 828 R&D technicians in a Chinese iron and steel manufacturing company. The study concluded that follower-rated LMX had an indirect effect on creativity via self-efficacy when LMX differentiation was low but not when it was high. This meant that creativity was highest when followers had high self-efficacy, were in high quality relationships, and at the

same time belonged to groups in which followers agreed on the quality of their relationship with the leader.

To conclude, the empirical findings and conclusions in the research on LMX and creativity indicate that high LMX can lead to more creative and innovative outputs in research groups. These findings, however, are somewhat inconclusive when different measures of creativity are used. Also, a number of cognitive moderating factors relevant to research work seem to be in play. These factors include cognitive style (Tierney et al., 1999), self-efficacy (Liao et al., 2010), personal initiative (Denti & Hemlin, 2012c), and job autonomy (Volmer et al., 2012).

There are not many studies on LMX in research. Of the studies available, a majority measure LMX uni-dimensionally, without respect to its multi-dimensionality (Joseph et al., 2011), measure LMX only from the followers' point of view (Gerstner & Day, 1997), and mainly focus on follower outcomes of LMX quality rather than leader outcomes (Wilson et al., 2010). Few studies investigate creativity in university research groups: the interest is more on creativity in industrial R&D. Moreover, to my knowledge, the effect of LMX on creative performance has never been examined longitudinally for more than six months. Most LMX studies are cross-sectional and more longitudinal studies have been called for (Gerstner & Day, 1997).

Summary of the Four Empirical Studies

Overall Aim

The overall aim of this thesis is to explore the relationship between leadership and creativity in research settings.

Methodological Considerations

The participants in this research were bio-scientific researchers working in groups at universities in Sweden and at bio-companies in Sweden. Studies I, II, and III were conducted in both academic and commercial research settings, while Study IV was conducted using a university sample.

We stated the following inclusion criteria for participation in the four studies. First, participants had to be members of a research group that operated in the biosciences (the biomedical and biotechnical research fields). Second, the research group had to work in research or R&D. Finally, to qualify as a group, research groups had to have a group leader and at least two research group members.

We identified the academic groups by consulting the webpages of Sweden's largest universities. To identify commercial groups, we consulted the bioscience website http://www.swedenbio.com/ and the yellow pages. We included university spin-off companies, start-up companies with proximity to academic research, and R&D-based small and medium sized enterprises (SME).[2] Of the approached research groups, about 16% of the academic research groups and 20% of the commercial research groups participated.[3] Several research groups from each university participated. Smaller companies had one participating research group and larger companies had as many as three participating research groups. We contacted the leaders of these research groups and asked them to invite two or three followers from their groups to participate in our studies. We asked these research group leaders to provide us with the names of male and female followers, followers with diverse backgrounds, and followers with different work experiences or academic seniority. In the next step, we approached the followers to request their participation.

[2] The largest company sampled had 110 employees.
[3] The non-response figures are imprecise since contacts in the early stages of data collection were made by telephone and therefore were subject to recording biases in contrast to the more secure email communication.

The participants were well educated. The followers in academia were doctoral students, post-doctoral students, senior researchers, and a few laboratory assistants. In the commercial groups, followers were primarily engineers, biologists, physicists, chemists, or physicians. Of the leaders and followers 92% and 48%, respectively, had a doctoral degree (e.g., in biology, physics, chemistry, medicine, or engineering). Among the followers in academia, 52% were doctoral students. None of the followers in the commercial research groups was a doctoral student. Of the leaders, 31% were women; of the followers, 53% were women.

A note on creativity.

In order to capture several aspects of creativity in research and to minimize common source bias, we attempted to measure creativity from various perspectives and sources (see Amabile, 1996; Podsakoff et al., 2003). Therefore, we measured several "hard" aspects of creativity or creative performance, such as registered patents, publications (peer-reviewed scientific publications by dyads) and h-index figures. In addition to these hard measures of creativity, we also collected subjective ratings of creativity. Leaders and followers rated the creativity in their groups on the item "My group is very creative" (scale ranging from 1 to 7). Leaders also rated the followers' individual creativity on the item "My group member is creative" (scale ranging from 1 to 7). Finally, to capture commercial creativity, commercial research group followers were asked to provide data on innovativeness (Hurley & Hult, 1998).

Our ambition was to use the collected measures to create an index of creativity. We failed in this ambition, however, because of missing data, lack of correlation among different indicators, and differences in how academic and commercial groups express their creativity. The patent data were intended as measures of the commercial aspects of creative performance. However, because few of the participating academic and commercial researchers had been awarded patents, the measure was of no use. The h-index data were also unsatisfactory, owing to excessive missing data.

The subjective ratings of creativity displayed issues of common source variance when tested against the LMX measures (i.e., leaders' creativity ratings were only correlated with leaders' LMX ratings, and followers' creativity ratings were only correlated with followers' LMX ratings). Also, using only one item for each subjective rating of group and individual creativity was inadequate for our purposes. The ratings of innovativeness (e.g., "Technical innovation, based on research results, is readily accepted". See Appendix 3) were negatively associated with followers' publications in the commercial research setting.

Therefore, eventually we excluded all measures of creativity from our analyses except for member dyad publications (MDP) (i.e., followers' peer-reviewed, scientific publications published while working with their leader) and leader dyad publications (LDP) data (leaders' peer-reviewed, scientific publications published while working with each follower).

Study I

Aim.

To explore how research group members perceive their leaders stimulate their creativity. When and how do research group leaders in academic and commercial research groups stimulate followers' creativity? Why are such incidents important to followers?

Method.

For Study I, we recruited 93 academic and commercial research group members to participate in structured interviews based on the Critical Incident Technique (Flanagan, 1956). Our application of the Critical Incident Technique required each participant to recall up to three incidents in which their leader had stimulated that group member's creativity or the group's creativity. When participants had recalled an incident, they were asked to give a detailed description of the incident including the situation, the leader's behavior, and the perceived reason for the importance of the incident. Seventy-five of the 93 participants could report at least one critical incident involving their group leader. Altogether, 153 critical incidents were reported. In all interviews, the interviewer(s) took notes. In addition, some interviews were tape-recorded when only one interviewer attended those interviews. The critical incidents were analyzed and categorized using a content analysis procedure (Miles & Huberman, 1994) based on the meaning contents of the situations, the leader behaviors, and the reasons given for the importance of the incidents. To assess the quality of our categories, we asked an independent judge to categorize a subsample of the critical incidents using our categories. We calculated kappa statistics and achieved satisfactory agreement.

Result.

We interpreted the findings as if the participants were able to identify leader-related incidents that had stimulated creativity (although about 20% could not report a single incident). The situations, leader behaviors, and reasons given for the importance of the incidents each generated six main categories. The following six categories of creativity-stimulating leader

behaviors were found: Provide expertise, Coordinate group research, Assign tasks, Support group conditions, Enhance external contacts, and Promote independence. In accordance with Yukl, Gordon, and Taber's (2002) taxonomy of general leader behaviors, the majority of the leaders' behaviors were change-oriented. Change-oriented behaviors were interpreted as the leaders' ability to stimulate creativity and to support followers' creative efforts. There was a strong emphasis on leader expertise in our findings, which is discussed in connection with literature on leadership and creativity, along with the three other largest leader behaviors identified to stimulate creativity. The leader behaviors described as stimulating creativity did not differ between the academic research setting and the commercial research setting. However, an examination of the categories of the critical incident situations and the reasons these situations were perceived as creativity-stimulating revealed more individually oriented responses in the academic research setting and a stronger sense of group orientation in the commercial research setting. We report on a few limitations of the study and of the use of the critical incident technique in terms of the conclusions that can be drawn from a study using a critical incident design, such as the reconstructive nature of memory influencing all retrospective interviews, and the notion that it is socially desirable to be perceived as creative.

Conclusion.

There are two main findings from Study I. First, group members in research settings can identify leader-related creative incidents. Second, the identified creativity-stimulating leader-behaviors support the argument that leader expertise and support, directed at individuals or groups, stimulate creativity. Although the academic researchers and the commercial researchers reported similar incidents, Study I revealed the more individualistic character of the incidents reported by academic researchers and the stronger group character of the incidents reported by commercial researchers.

Study II

Aim.

To explore two task-related leader work behaviors, Cognitive Support and Knowledge Resources, as antecedents of leader-follower relationship quality in the four LMX-MDM sub-dimensions: Affect, Loyalty, Contribution, and Professional Respect.

Method.

Leaders' expertise is valued in research groups because of its influence on followers' creativity (Hemlin, 2006; Hemlin & Olsson, 2011; Mumford et al., 2002). Additionally, the quality of the LMX relationship in workgroups has been related to followers' performance and, in a few cases, to creativity (Gerstner & Day, 1997; Scott & Bruce, 1994; Tierney et al., 1999). Based on this research, Study II investigated if two components of leader expertise were related to different aspects of leader-follower relationship quality using the 12-item multi-dimensional LMX-MDM (Liden & Maslyn, 1998) sub-dimensions. Two leader behaviors aimed at facilitating followers' task-fulfillment, Cognitive Support and Knowledge Resources, were suggested as possible antecedents to followers' feelings of affect for their leader (LMX-MDM Affect), the loyalty of their leader (LMX-MDM Loyalty), their readiness to contribute to work (LMX-MDM Contribution), and their professional respect for their leader (LMX-MDM Professional Respect).

One hundred and sixty-six followers reported LMX-MDM combined with Cognitive Support and Knowledge Resources. The latter two scales were based on findings from a previous study on leadership and teams that was conducted in the biosciences (Hemlin, 2006). Cognitive Support is task-related in the sense that it refers to leaders' cognitive support for followers in different stages of the work process, such as in problem construction, in assessment of alternatives, and in implementation of the solution. Knowledge Resources is a more infrastructural variable assumed to measure the extent to which leaders meet followers' information needs, provide important contacts, and offer the relevant knowledge needed for followers to conduct and excel in their work. Leaders can only exert indirect control over LMX relationship quality, but possess full control over the leader behaviors Cognitive Support and Knowledge Resources.

The following hypotheses were tested:

Hypothesis 1: Research group leaders' Cognitive Support is positively related to the four sub-dimensions in LMX-MDM: Affect, Loyalty, Contribution, and Professional Respect.

Hypothesis 2: Research group leaders' Knowledge Resources are positively related to the four sub-dimensions in LMX-MDM: Affect, Loyalty, Contribution, and Professional Respect.

We conducted a confirmatory factor analyses (CFA) modification of Harman's One Factor Test (Mossholder, Bennett, Kernery, & Wesolowski, 1998) to examine the four-dimensionality of LMX-MDM. The aims of the analyses were to ensure that the three scales

(Cognitive Support, Knowledge Resources, and LMX-MDM) measured independent constructs and to check for common method variance. Since our data were nested (i.e., groups of two to three followers with the same leader), we statistically controlled for these dependencies by conducting Hierarchical Linear Modeling (HLM) using MLwiN 2.22. We wanted to investigate whether any of the four LMX-MDM sub-dimensions (Affect, Loyalty, Contribution, and Professional Respect) could be predicted from followers' ratings of leaders' Cognitive Support or provision of Knowledge Resources. First, we began with unconditional models for each of the four sub-dimensions as a way to identify variance in the sub-dimensions (either on individual or group levels). Second, we entered one predictor (Cognitive Support or Knowledge Resources) with the control organizational setting (academic, commercial) in the random intercept model. Each empty model was compared to its corresponding random intercept model to determine whether the predictors reduced the amount of unexplained group level variance. The level at which unexplained variance was reduced was interpreted as the level where the independent variable constructs affected the dependent variable.

Result.

Our findings show that Cognitive Support and Knowledge Resources related to the sub-dimensions of LMX-MDM: Affect, Loyalty, Contribution, and Professional Respect. All predictions were supported except for a failed relationship between Cognitive Support and Loyalty. Hypothesis 1 was thus partially supported and Hypothesis 2 was fully supported. We therefore suggest that research group leaders can behave in such a way that they improve the quality of their relationship with followers by providing them with Cognitive Support and Knowledge Resources. When leaders provide Cognitive Support and Knowledge Resources, followers like their leaders, respect them professionally, and work hard for them. Additionally, followers also perceive leaders as loyal when leaders provide Knowledge Resources.

Cognitive Support and Knowledge Resources did not appreciably affect the four LMX-MDM sub-dimensions differently. Both the task-related sub-dimensions (Contribution and Professional Respect) and social sub-dimensions (Affect and Loyalty) of LMX were largely predicted by Cognitive Support and Knowledge Resources, which indicate that these leader behaviors improve the overall relationship quality and not certain unique aspects of the relationship.

Conclusion.

We conclude that leaders should provide followers with Cognitive Support and Knowledge Resources in order to improve LMX quality since improved LMX quality is expected to lead to positive work outcomes for the individual follower as well as for the workgroup and the larger organization (Gerstner & Day, 1997). It is, however, acknowledged that the relationship may be reversed: Leaders may provide Cognitive Support and Knowledge Resources to followers with whom they already have a high quality relationship.

Study III

Aim.

To study the relationship between LMX and creative performance using a multi-level approach, and to examine if leader ratings of LMX (SLMX) and follower ratings of LMX (MLMX) can predict leaders' and followers' individual creative performance.

Method.

Study III is a survey study. The participants were 137 leader-follower dyads in 30 academic research groups and 24 commercial research groups (2 or 3 followers per research group). The leaders and followers in the dyads rated their mutual relationship quality using the multi-dimensional LMX measure (SLMX-MDM (Greguras & Ford, 2006) for leaders and the LMX-MDM (Liden & Maslyn, 1998) for followers. The use of these questionnaires allowed both leaders and followers to express their opinions on the overall LMX quality and on the specific sub-dimensions of Affect, Loyalty, Contribution, and Professional Respect. Individual creative performance was measured as a member's dyad publications (MDP) (i.e., followers' peer-reviewed, scientific publications published while working with their leader) and a leader's dyad publication (LDP) (leaders' peer-reviewed, scientific publications published while working with each follower).

The following hypotheses were tested:

Hypothesis 1a. The quality of dyadic leader-member relationships influences the individual creative performance.

Hypothesis 1b. The quality of research group contexts affects individual creative performance beyond the influence of dyadic leader-member relationships.

Hypothesis 2. Each LMX-MDM sub-dimension (Affect, Loyalty, Contribution, and Professional Respect) relates to individual creative performance in a research group.

Hypothesis 3. Creative performance manifests itself differently in academic and commercial research groups because a) LMX is more strongly related to publications in the academic setting than in the commercial setting, and b) LMX is more strongly related to patents in the commercial setting than in the academic setting.

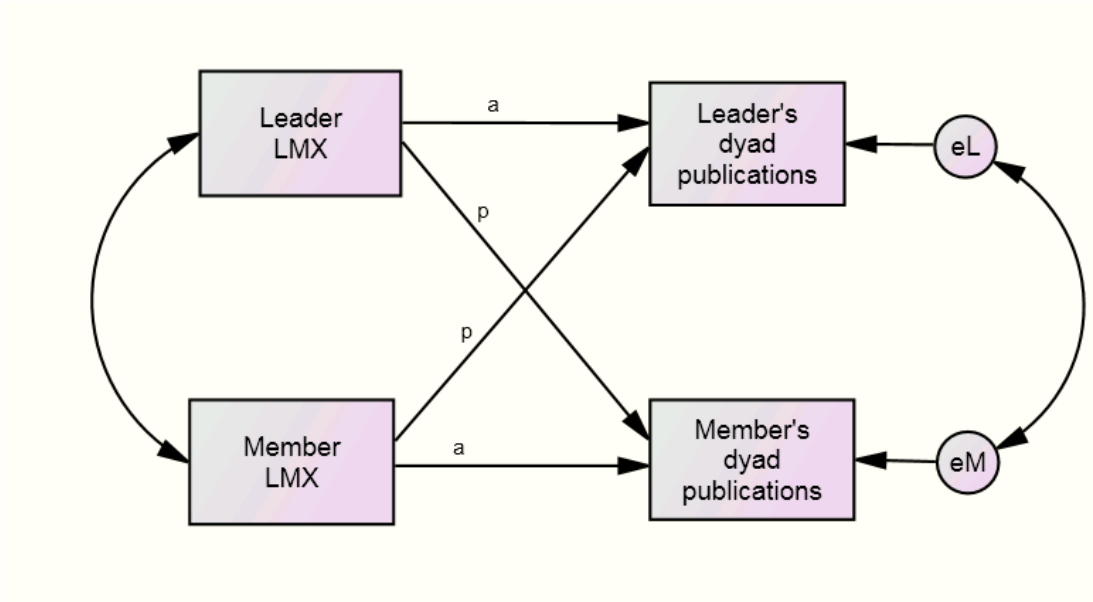

Figure 1. The Actor-Partner Interdependence Model applied to LMX and creative performance as publications. Regressions labeled with "a" represent actor effects and regressions labeled with "p" represent partner effects.

As a framework for the analysis, we applied the Actor-Partner Interdependence Model (APIM; Kenny, 1996; Kenny & Cook, 1999, Kenny, Kashy, & Cook, 2006). See Figure 1. The Model was estimated using multi-level modeling (MLM). The multi-level analysis was implemented with the MLwiN version 2.22 software that uses the iterative generalized least squares (IGLS) for the estimation process. The Model was set up as a multivariate response model following the two-intercept approach described by Cook and Kenny (2005). Thus, regression equations predicting leaders' and members' publications were estimated simultaneously; the dependency between leaders' and members' publications was modeled as the covariance between the random intercepts for the leaders and the members. Non-independence, which occurred when the same leader appeared in several dyads and when

members worked with the same leader and same group, was modeled as random intercepts at the group level.

Result.

It became evident in our analyses that data from the academic and commercial subsamples had to be analyzed separately because the academic researchers published more than the commercial researchers and because the relationship between LMX and creative performance differed between the two organizational settings.

Our findings showed that LMX at least partially positively predicted individual creative performance in the academic research groups: group level SLMX predicted LDP and tended to predict MDP. This suggests that it is conducive to creative performance to belong to an academic research group where the group leader, on average, rates LMX quality as high. MLMX, irrespective of level, was unrelated to both LDP and MDP in the academic research setting.

In the commercial research setting, the dyadic level SLMX negatively predicted LDP. Moreover, group level MLMX negatively predicted MDP in the commercial research setting. This suggests that it is detrimental to commercial research group followers' creative performance to have leaders who view their LMX quality as high, or belong to a group where followers on average rate LMX quality as high.

These findings suggest that a general tendency of LMX is that it is conducive to LDP and MDP in academic research groups but detrimental in commercial research groups. Leaders did not differentiate significantly between their relationships as far as different members of their groups, while MLMX differed within groups. We conclude that both dyadic and group level effects of MLMX and SLMX were encountered, and that there was partial support for Hypotheses 1a and 1b.

With respects to Hypothesis 2, not all sub-dimensions (leader-rated or follower-rated) predicted *both* leader *and* follower creative performance. However, each sub-dimension at least tended to predict *either* leader *or* follower creative performance *in some part of the dyadic system* (see Figure 2). Hypothesis 2 was therefore partly supported.

The analyses of LMX-MDM sub-dimensions revealed differences between the two organizational settings, and the two perspectives on LMX (leader-rated vs. follower-rated). In the academic research groups, leaders' perceptions of follower loyalty (SLMX-MDM Loyalty) were conducive to LDP, and leaders' contributions to work goals (SLMX-MDM

Contribution) tended to be conducive to LDP. In academia, leaders' contributions to work goals (SLMX-MDM Contribution) were predictive of MDP. Three other sub-dimensions: leaders' and followers' professional respect for one another (LMX-MDM Professional Respect and SLMX-MDM Professional Respect), and followers' liking of working with their leader (LMX-MDM Affect) tended to predict MDP.

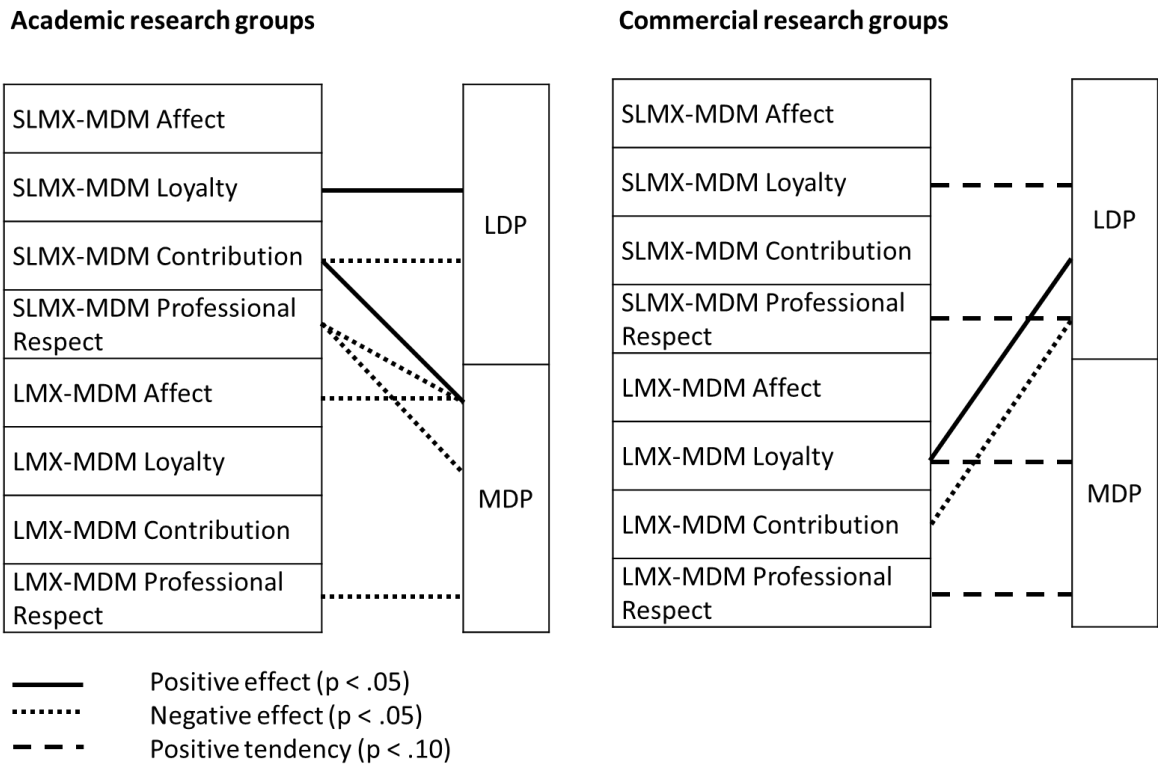

Figure 2. An illustration of the summarized findings of the associations between LMX-MDM and SLMX-MDM sub-dimensions, and leader dyad publications (LDP) and group member dyad publications (MDP), in academic research groups and commercial research groups. Each sub-dimension's association with LDP and MDP was modeled and tested separately.

In the commercial research groups, leaders' like of working with their followers (SLMX-MDM Affect) and professional respect for their followers (SLMX-MDM Professional Respect) negatively predicted LDP. Additionally, leaders' perceived loyalty (LMX-MDM Loyalty) was conducive to LDP, and followers' work efforts (LMX-MDM Contribution) tended to be so as well. Leaders' loyalty (LMX-MDM Loyalty) and followers'

professional respect for leaders (LMX-MDM Professional Respect) negatively predicted MDP.

To conclude, the general tendency is that when associations between an LMX-MDM sub-dimension and creative performance are encountered, the associations are positive in the academic research setting and negative in the commercial research setting (with one exception: LMX-MDM Contribution positively predicted LDP).

Hypothesis 3, which proposes that a) LMX would be more strongly related to publications in academic research than in commercial research, and b) would be more strongly related to patents in the commercial setting than in the academic setting, was only partially testable due to the dysfunctional measures for patents. Creative performance manifested itself differently in the two settings. Publications were partially related to LMX in both the academic research groups and the commercial research groups, but, as noted, the relationship was positive in the academic research groups and negative or mixed in the commercial research groups. In the commercial research group setting publications are probably less valued creative outcomes. Thus, there was partial support for Hypothesis 3a, while Hypothesis 3b remained untested.

Conclusion.

Study III concludes that the dyadic exchanges between a leader and a follower are nested in a higher order structure, namely the workgroup and the organization. Leader ratings of global LMX were more influential on creative performance than followers' ratings of global LMX. Group levels of leader ratings and follower ratings tended to be more influential than dyad level ratings. Moreover, the relationship between global LMX and creative performance was positive in the academic research groups and negative in the commercial research groups. We argue that these results relate to contextual settings because publishing is not a creative activity that is valued equally in the two settings.

Our findings indicate that certain sub-dimensions of exchanges between leaders and followers are relevant to creative performance, both positively and negatively, depending on whether the research setting is academic or commercial. LMX-MDM sub-dimensions were also differently related to creative performance, depending on leaders' or followers' perspectives.

The mixed results and relatively low correlations in this study lead to no clear conclusion on the LMX-MDM sub-dimensions-creative performance relationship. However,

our results indicate that LMX theory merits analysis from a multi-dimensional, multi-target (leader and follower), and multi-level perspective, as scholars in the field have emphasized (Gerstner & Day, 1997, Schriesheim et al., 1999; Schyns & Day, 2010; Yammarino et al., 2005). Our results also indicate that the number of publications is a less than perfect measure of creative performance in the commercial research setting. The commercial research group participants had few publications, resulting in a low variance in the publication measure.

In sum, we found LMX to be partially related to creative performance in research groups, leaders' perceptions of LMX quality to be the more influential on leaders' and followers' creative performance than followers' perceptions of LMX quality. Moreover the association between LMX and creative performance tended to be positive in the academic research groups, but negative in the commercial research groups.

Study IV

Aim.

To study the longitudinal effects of leader ratings of LMX (SLMX), follower ratings of LMX (MLMX) and LMX balance (i.e., leader-follower agreement on relationship quality) on followers' past and future creative performance.

Method.

Study IV was a longitudinal study of the academic subsample from Study III. This study was conducted as a response to the call for longitudinal studies on LMX (Graen & Uhl-Bien, 1995) and as a contribution to the LMX debate concerning leader-follower agreements on their relationship and their consequences (Schyns & Day, 2010). Of the 97 academic leader-follower dyads in Study III, 82 dyads participated in Study IV in which I aimed to investigate two issues: 1) the longitudinal effects of LMX on creative performance, and 2) the effects of LMX balance on creative performance. As in Study III, LMX was measured from both leaders' and followers' perspectives using the 12-item multi-dimensional LMX measure SLMX-MDM (Greguras & Ford, 2006) for leaders, and LMX-MDM (Liden & Maslyn, 1998) for followers.

Three measures of followers' creative performance were measured: *Past creative performance, Past creative performance/year,* and *Future creative performance*. The MDP data collected for Study III were used to measure Past creative performance and Past creative

performance/year. To measure followers' Future creative performance, I collected complementary, non-overlapping follow-up MDP data (followers' peer-reviewed, scientific publications published between June 2009 to May 2012 (i.e., *after* LMX measurement) using database archives (i.e., ISI Web of Science and PubMed). I performed these measurements approximately three years after the data collection for Study III.

I hypothesized both leaders' and followers' LMX ratings to be predictive of followers' retrospective as well as prospective creative performance:

Hypothesis 1: MLMX will be positively associated with followers' past creative performance within dyads.

Hypothesis 2: SLMX will be positively associated with followers' past creative performance within dyads.

Hypothesis 3: MLMX will be positively associated with followers' future creative performance within dyads.

Hypothesis 4: SLMX will be positively associated with followers' future creative performance within dyads.

I also examined the concept of LMX balance (i.e., leader-follower agreement on relationship quality) in relation to retrospective and prospective creative performance. Although the idea of mutuality and agreement in relationships is at the core of LMX theory, the leader-follower agreement is generally low (Gerstner & Day, 1997; Sin et al., 2009). In line with a framework developed by Cogliser et al. (2009), I placed each dyad in the sample in one of four categories of relationship quality: balanced/high (both the leader and the follower rated LMX quality as above median), balanced/low (both the leader and the follower rated LMX quality as below median), follower underestimation (the leader rated LMX quality as above median, while follower rated LMX quality as below median), follower overestimation (the follower rated LMX quality as above median, while the leader rated quality as below median). These relationship types were examined in relation to followers' creative performance.

I proposed two hypotheses based on previous research:

Hypothesis 5: LMX balance will be associated with followers' past creative performance. Among the four LMX balance relationship types (balanced/high, balanced/low, follower underestimation, follower overestimation), followers in balanced/high relationships will

display the highest creative performance and balanced/low relationships the lowest. Creative performance in imbalanced relationship types is intermediate, with followers in follower underestimation relationships outperforming followers in follower overestimation relationships.

Hypothesis 6: LMX balance will be associated with followers' future creative performance over three years' time. Among the four LMX balance relationship types (balanced/high, balanced/low, follower underestimation, follower overestimation), followers in balanced/high relationships will display the highest creative performance and balanced/low relationships the lowest. Creative performance in imbalanced relationship types is intermediate, with followers in follower underestimation relationships outperforming followers in follower overestimation relationships.

Dyad age and academic position (doctoral student, non-doctoral student) were controlled for in analyses.

Result.

Findings showed that SLMX but not MLMX predicted both retrospective and prospective creative performance (in support of Hypothesis 2 and Hypothesis 4, but not Hypothesis 1 and Hypothesis 3). This suggests that leaders' perceptions of LMX relationship quality are conducive to creative performance in the academic research setting.

When LMX balance (i.e., leader-follower agreement on relationship quality) was taken into account, followers in dyads where leaders and followers agreed on high relationship quality outperformed all other relationship types. This was true for the retrospective creative performance (in support of Hypothesis 5). Surprisingly, the examination of LMX balance at the follow-up did not support Hypothesis 6. This indicated that MLMX was partially meaningful to followers' past creative performance but not to followers' future creative performance.

Conclusion.

In summary, SLMX was found longitudinally influential on a hard measure of followers' past and future creative performance in the academic research groups, while MLMX was not. I conclude that SLMX has consistent effects across time. Moreover, I also conclude that relationship quality should be measured from both leader and follower perspectives. When LMX balance, that is, the four LMX relationship types (balanced/high, balanced/low, follower underestimation, and follower overestimation) are taken into account, followers in leader-

follower relationships – where both parties agree on high LMX quality – outperformed all other relationship types. This was true retrospectively but not prospectively.

General Discussion and Conclusions

The Influence of Leaders on Individual Creativity

The overall aim of the thesis was to explore the relationship between leadership and creativity in research groups. To that end, we conducted four empirical studies in academic and commercial bioscience research group settings. First, we performed a qualitative study by identifying creativity-stimulating, leader-initiated incidents (Study I). Second, we explored certain leader behaviors as antecedents of LMX (Study II). Third, we examined LMX and each of its sub-dimensions in relation to leaders' and followers' creative performance (i.e., their separate publication numbers within dyads) in both the academic and commercial research groups (Study III). Finally, I conducted a follow-up (Study IV) of an academic subsample to explore the longitudinal effects of LMX and LMX balance on followers' past and future creative performance.

The overall findings indicate that leaders are influential on creativity in research. This conclusion is consistent with previous suggestions by scholars investigating leadership and creativity (e.g., Elkins & Keller, 2003; Mumford et al., 2002). In Study I, followers found the following leader actions stimulated their creativity: leaders' provision of expertise, co-ordination of a group's research work, delegation of tasks, and support of group conditions and followers' wellbeing. Study II, which did not explicitly involve creativity, suggested that leaders' provision of Cognitive Support and Knowledge Resources were influential on LMX, a variable that has been previously related to creativity. The findings on LMX in Study III suggest that the leader perspective on leader-follower relationships is conducive to creative performance in academic research groups. We acknowledge that the term conducive may be misleading since the causal direction between LMX and performance is not established. Moreover, the creative performance measure in Study III is not a cross-sectional measure of creative performance, but rather a retrospective measure of creative performance. However, the findings from Study IV complement findings from Study III in their confirmation that SLMX is conducive to creative performance in academic research settings, even after three years. The dyad publication data used in Study IV were non-overlapping with the data used in Study III, lending additional strength to these conclusions. However, we found some inconsistencies in the findings, as well as some findings that contradicted LMX theory. These findings are discussed in relation to the relevant literature in a subsequent section.

In following the recommendations in the literature to study leadership and creativity more integratively (Amabile, 1996, Csikszentmihalyi, 1999; Harrington, 1990; Hemlin et al., 2008; Mumford et al., 2002; Woodman et al., 1993), we included both SLMX and MLMX ratings of LMX (Study III and Study IV) and their respective creative outputs (Study III). In the qualitative study (Study I), the participants defined creativity. In the quantitative studies that assessed creativity (Study III and Study IV), creativity (or creative performance) was limited to the measure of dyad publications (since other measures of creativity failed). The findings from the two organizational settings revealed similarities in how leaders stimulated creativity (Study I) and in how LMX was rated (Study II, Study III, and Study IV), but also differences in terms of how creativity was expressed and related to leader-follower relationships in the two settings. These findings are discussed in relation to the relevant literature in a subsequent section.

Similarities and Differences in Academic and Commercial Research Settings

I studied the academic research groups and the commercial research groups jointly in this thesis (Study I, Study II, and Study III) because their settings share many characteristics. Leadership in both research settings is challenged by the exploration of ill-defined problems. This means that leaders have to make decisions and secure funding under conditions of relative uncertainty. Despite the two settings' different objectives – scientific publications vs. commercial products – I expected work in both settings to require phases of unprejudiced idea generation and more focused, finalizing phases of idea implementation (Reiter & Palmon-Illies, 2004). Therefore, I did not expect that the settings would differ as far as the influence of leadership on creativity. Study I showed that the expectation was correct and the method of using a joint investigative strategy was successful. The joint strategy revealed that the two settings did not differ significantly as far as which leader behaviors stimulated creativity. The only difference we observed between the two settings was the greater emphasis in the academic research setting on individual development (more supervision/expert advice situations, more travel, and more professional development) and the greater emphasis in the commercial research setting on the group social issues (conflict resolution, support of group conditions).

The joint study strategy was also successful in Study II where we found the suggested antecedents of LMX largely related to LMX. Rather, the difficulties with the joint comparison

arose in the study of the creative outcomes in the two settings (Study III). This was largely due to the failed development of a creativity index based on the various creativity measures we used.

In agreement with other researchers in this field (Kasperson, 1978; Pelz & Andrews, 1966), we assumed that scientific publications and patents, respectively, would be appropriate outcome measures for academic research groups and commercial research groups (see Jung et al., 2008). Despite previous scholars' findings that both academic and commercial research groups publish scientific papers (Berends et al., 2006), the commercial researchers in our sample published significantly fewer scientific articles than the academic researchers. Also, we did not find that publishing and patenting reinforced each other in academia (Van Looy et al., 2006); the academic researchers in the sample reported few patents. Similarly, the commercial researchers reported few patents. The explanation for the latter result may be that we sampled commercial research groups in relatively small and new companies that had not yet had the time, money or sufficient incentives to file patent applications.

The results of Study III (Hypotheses 3a), which showed that LMX was negatively associated with publications in the commercial research setting, suggest that commercial research groups in the sample prioritize publications less than marketable innovations. In some stages of work, scientific publishing might even interfere with marketing strategies. This may be a reason for the negative direction of the association between publications and LMX in the commercial research groups.

As noted, creativity, which is proposed to be domain-specific, should therefore be investigated as a function of its specific domain (Amabile, 1996; Ludwig, 1995). Despite the fact that the academic researchers and the commercial researchers were in similar research fields, we were unable to create a valid and reliable index of creativity. Because they were in different organizational contexts, they did not work to achieve the same creative output. While the academic research setting (public organizations) can be assumed to be largely driven by problems (research questions) that require solutions (answers), commercial research (private organizations) are ultimately driven by identifying needs and by the benefits of satisfying them (supply and demand).

Advantages and Shortcomings of LMX

LMX was partially related to creative performance in research groups and thus found to be a theory that is useful in understanding leadership in research groups. Other leadership theories risk placing too much emphasis on leaders and their individual characteristics and behaviors, and risk underestimating the importance of followers in the construction of leadership. Leadership is to a great extent a relational phenomenon. The inclusion of followers in leadership may be particularly sensible in research since research group followers possess high levels of expertise and may be able to lead themselves and each other. Additionally, the use of LMX-MDM allowed for detailed examinations of which particular aspects of a leader-follower relationship were conducive to creative performance in the research setting.

SLMX and MLMX.

It has been recommended that LMX be measured from both leaders' and followers' perspectives (Gerstner & Day, 1997). That is the methodology followed in this thesis in which I confirmed the traditional observation that the correlation between these two perspectives is fairly low. The two perspectives appeared to measure two separate constructs. According to a meta-analysis by Joseph et al. (2011), SLMX and MLMX are two separate although related constructs. The leader-follower agreement in this study was low. The overall leader-follower agreement was $r = .18$ ($p < .05$) (academic groups: $r = .09$, n.s.; commercial groups: $r = .25$, $p < .01$) (Study III). One may question whether it is useful to measure both leader and follower LMX. I claim you should. Findings from the studies in this thesis show that the two perspectives measure different and important aspects of the relationship.

Study III and Study IV showed that leader and follower perspectives of LMX measured two separate constructs. SLMX but not MLMX predicted creative performance. SLMX (at the group level) predicted leaders' creative performance and tended to predict followers' creative performance in academia (Study III). In contrast to predictions, and at odds with LMX theory, MLMX was found to be less successful at predicting creative performance. MLMX did not influence creative performance in academic research groups. In commercial research groups, when assessing the effects of global LMX on creative performance, MLMX (at the group level) negatively predicted followers' creative performance. Moreover, leader and follower perspectives on each of the sub-dimensions were found differently related to creative performance, further suggesting that leader and follower perspectives measure unique and important aspects of the leader-follower relationship.

The finding that MLMX was less predictive of creative performance than SLMX is at odds with LMX theory but agrees with findings from previous research. According to a meta-analysis (Gerstner & Day, 1997), the correlation between LMX and performance differs, depending on whether LMX and/or performance is leader-rated or follower-rated. Not surprisingly, they found that SLMX ratings were more strongly related to leaders' subjective ratings of follower performance than MLMX (Gerstner & Day). Many LMX studies are cross-sectional and use subjective ratings of creativity. Study IV therefore extended previous knowledge of LMX by longitudinally replicating the effects of SLMX on an independent source measure of followers' creative performance at one point in time, at a follow-up three years later.

In Study III and Study IV, SLMX was overall a stronger predictor of creative performance than MLMX. However, in Study IV, where LMX balance was investigated, MLMX to some extent related to creative performance. Followers in relationships in which the leader and the follower agreed that LMX quality was high creatively outperformed followers in all other relationship types (i.e., imbalanced LMX relationships and relationships with admittedly low LMX quality according to both leader and follower). This finding is consistent with Elkins and Keller's (2003) assumption on LMX in R&D: that less-than-high-quality relationships do not contribute to project effectiveness. Surprisingly, the examination of the effects of LMX balance on prospective publication data did not provide the same result. MLMX ratings were therefore partly judged meaningful as predictors of creative performance retrospectively but not at all prospectively.

How can the superior ability of SLMX to predict creative performance be understood? As noted in the literature (e.g., Bauer & Green, 1996; Diensch & Liden, 1986), the causal direction between LMX and performance is not established. LMX and performance may be intertwined as they influence and reinforce one another. Perceptions of past performance are therefore likely to influence the leaders' and followers' LMX ratings. From experience, leaders become accustomed to identifying talent and predicting future performance. Followers, on the other hand, may be more biased and may overestimate their past and future achievements. This difference may explain why SLMX ratings were more successful in predicting followers' creative performance, both retrospectively and prospectively, than MLMX ratings. As noted above, SLMX is better than MLMX at assessing followers' (leader-rated) performance (Gerstner & Day, 1997). The hard, independent measures of creative performance used in relation to LMX are understudied and merit further investigation. The

effect size of the relationship between LMX and such objective performance measures is small (r = .11, Gerstner & Day, 1997).

In conclusion, I concur with the recommendation that LMX should be measured from both leader and follower perspectives. However, one cannot necessarily expect leader-follower agreement between LMX-MDM and SLMX-MDM.

LMX: A uni- or multi-dimensional construct?

This thesis confirmed other scholars' findings (Joseph et al., 2011; Liden & Maslyn, 1998) on the multi-dimensionality of LMX-MDM (Study III). Each sub-dimension of LMX-MDM (when leader-rated or follower-rated) highlights a unique aspect of the leader-follower relationship. Each aspect has the potential to help increase our understanding of the leader-follower relationship and its relation to work outcomes for individuals, groups, or organizations. However, the results of the multi-level, multi-perspective, and multi-dimensional analyses were difficult to interpret conclusively (Study III). All LMX-MDM sub-dimensions predicted leader or follower publications in some part of the dyadic system (i.e., they predicted either leaders' or followers' dyad publications, when either leader-rated or follower-rated).

One may question the usefulness of multi-dimensional LMX because the leader and follower ratings of the sub-dimensions related differently to the creative outcomes. The two perspectives did not contribute to our understanding of the importance of each sub-dimension. Since the leader and follower ratings of sub-dimensions did not agree, it may make more sense to treat LMX as a single, broad construct. Most previous LMX research uses this approach. Since 1999, most scholars who use LMX-MDM treat it as a uni-dimensional measure (72%) despite the confirmed validity of the LMX-MDM sub-dimensions (Joseph et al., 2011; Liden & Maslyn, 1998). The global measure of LMX-MDM is highly correlated with the most commonly used LMX measure (LMX-7) (r = .8 – .9), and the two are used in a majority of the current LMX literature. The strong tendency to treat LMX as uni-dimensional (i.e., neglect the sub-dimensionality of LMX-MDM) might be positive because the field of LMX has for a long time disagreed on how to measure LMX (Joseph et al., 2011; Schriesheim et al., 1999). Increased agreement on how to measure LMX would facilitate comparisons across studies, increase replicability and lead to more conclusive results on LMX and its relation to creativity.

Theoretical interests should guide scholars in deciding whether to study LMX as a uni-dimensional or a multi-dimensional construct. If specific aspects of the leader-follower relationship are of interest, the LMX-MDM sub-dimensions have documented validity (Liden & Maslyn, 1998; Joseph et al., 2011) and should be used. In this thesis, the sub-dimensions were similarly related to the proposed antecedents in Study II (as theorized) and difficult to overview in Study III. The uni-dimensional LMX that measures overall relationship quality has the advantage of requiring fewer participants than LMX-MDM. On the other hand uni-dimensional LMX (measured as LMX-7) has been shown to have low discriminant validity beyond satisfaction with supervisors (Joseph et al., 2011). A uni-dimensional LMX can thus be criticized as merely a measurement of "the liking of one's boss".

Does LMX really measure dyadic exchange?

LMX-MDM is defined as the quality of the dyadic relationship between a leader and a follower (Liden & Maslyn, 1998). Yet if leaders and followers agree only partially on the quality of their relationship (as most research shows), what do we really measure? Does low LMX agreement equal poor relationship quality? Low LMX agreement can be understood in different ways. First, some scholars prefer the terms *convergence* (Schriesheim, Wu, & Cooper, 2011) or *congruence* (Cogliser et al., 2009) because they think the term *agreement* is somewhat misleading. SLMX and MLMX do not always rate a common target.[4] Therefore, ratings are not necessarily expected to correlate. In LMX-MDM (and its corresponding SLMX-MDM), for instance, leaders and followers rate their liking of the *other* (Affect); their trust in the *other's* loyalty (Loyalty); their *own* contributions to work fulfillment (Contribution); and their professional respect for the *other* (Professional Respect).

These ratings are not necessarily expected to correlate since leaders and followers may be loyal or contribute to different extents. Rather, what is assessed is if leaders and followers provide these exchanges to *equal extents*. A theoretical suggestion is that an exchange may be reciprocated in kind, but other exchange resources may also be offered (Wilson et al., 2010). Therefore, exact agreement in the separate sub-dimensions should probably not be expected or even be necessary. It is perhaps more important that the relationship is perceived as just and that the expectations from roles are fulfilled rather than that the relationship consists of equal leader-follower exchanges of, for example, loyalty or professional respect. The different formal roles of leaders and followers mean that leaders and followers are in fact expected to provide qualitatively different contributions in their work. To conclude, I argue that leader-

[4] However, in LMX-7 (Graen & Uhl-Bien, 1995), leader and followers rate a common target.

follower exchanges that are unequal at the level of separate LMX-MDM sub-dimensions are not necessarily indicators of poor leader-follower relationships.

However, the low agreement is uncomfortable when using the uni-dimensional LMX-7 or a composite measure of the LMX-MDM measure. One explanation for the relatively low agreement is the attributional and social desirability biases caused by mere wording in items (Schriesheim et al., 2011). Moreover, another study has identified moderating factors that need to be taken into account when studying LMX agreement. Sin et al. (2009) found that LMX agreement increases with longer dyadic tenure and higher interaction frequency. Relationship tenure and interaction intensity can therefore help explain the lack of agreement in leader-follower relationship ratings.

As noted above, a recent meta-analytical examination confirms that SLMX and MLMX are two related but separate constructs (Joseph et al., 2011). These authors argue that this situation need not be problematical for LMX-MDM and SLMX-MDM because the leader and follower constructs can "meaningfully parse the LMX construct space" (Ibid., p. 124). This means that an examination of the extent to which a dyad party both receives and reciprocates each sub-dimension is required to provide full coverage of the dyadic system. In order to really capture all aspects of this construct space, then, measurement of LMX should be more extensive than the Actor-Partner Interdependence Model analyzed in Study III. Such measurement would require large samples and even more sophisticated statistical analyses.

Positive outcomes are to be expected from being part of a good group.

Theoretically, LMX is dyadic. However, in Study III, we found SLMX at the group level to exert the main influence on leaders' and followers' creative performance in academic research groups. I interpret this finding to mean that belonging to an academic research group in which, on average, leaders rated LMX quality as high is beneficial for individual creative performance. According to Schyns and Day (2010), previous empirical findings corroborate that good outcomes are expected when group members belong to a group in which overall LMX quality is high. Leaders should therefore strive to develop relationships of high LMX quality, high LMX agreement between leader and follower, and high consensus on high quality in the group (Schyns & Day, 2010).

This thesis treats creativity as an individual level construct (although we also allowed for critical incidents that stimulate individual or group creativity in Study I). Creativity is an individual level construct because all creative achievement initially emanates from

individuals. But, as with leadership, results from research on creativity at the individual level may not automatically translate to the group level. Sawyer (1999, p. 448) argued that creativity in improvisational theater groups was "not predictable from knowledge of its components, and not decomposable into those components." In other words, the group creativity in the theater groups was different from the actors' individual improvisational creativity. This may also be the case in scientific research.

Drawing on a study by Tindale and Kameda (2000), who introduced the concept of the social sharedness, I suggest that good outcomes arise from group membership in which overall LMX quality and overall creativity are high. The explanation is that the sharing of attitudes, norms, identities, and cognitive processes in groups has greater influence on group outcomes than other attitudes that are less shared. Therefore, there may be a spillover effect from working with other creatively talented people in groups in which leader-follower relationships are positive.

There may also be the opposite effect: "good groups" attract the "right" people. A classic sociological study indicated that eminent researchers and students could identify promising, yet undeveloped research fields as well as potentially eminent researchers in those fields at early stages (Zuckerman, 1967). As students, and before either they or their supervisors had been awarded Nobel prizes, future Nobel laureates often worked with other future Nobel laureates. In conclusion, regardless of the direction of causality between LMX and creative performance, positive individual effects are likely to occur when an individual is part of a group in which relationships are positive (as viewed as such by the leader) and in which other group members are creative. These conclusions are in line with conceptual work on LMX (Schyns & Day, 2010) and based on my analyses of academic research groups. However, one may speculate that the conclusions may also be valid in commercial research groups if an appropriate measure of commercial creative output is used.

Future of LMX.

The findings in this thesis were inconclusive with respect to the importance of the separate LMX-MDM sub-dimensions in relation to creative performance. Future studies using multi-dimensional LMX would benefit from measuring both leaders and followers as providers of Affect, Loyalty, Contribution, and Professional Respect, and as reporters of the other party's exchange of these resources. As it is now, the LMX-MDM and SLMX-MDM measures do not provide full coverage of the exchanges in the dyadic system. It is not clear what the gains would be from extending the Actor-Partner Interdependence Model used in Study III to

incorporate all these aspects. Given the various findings in this thesis, one may question the practical relevance of the LMX-MDM sub-dimensions. The tendency in the field seems to point toward treating LMX-MDM as one broad, single construct (Joseph et al., 2011).

Limitations.

Perhaps the most severe limitation of this thesis is that non-random sampling was used in all our studies. Random sampling was not possible because of difficulties in clearly defining in advance the groups that belonged to the investigated population. By using opportunity sampling, we maximized the number of participants, which is a strength. Another limitation is that instead of sampling entire research groups, we sampled only two or three participants from each research group (groups that had from 2 to 20 members). Moreover, we did not select the participating group members from each group randomly. Instead, we gave group leaders inclusion criteria and asked them to identify potential followers for participation. This was done to sample a maximum number of participating groups and to facilitate the sampling process. The extent to which two or three non-randomly sampled group members can be said to fully represent a group of 20 is questionable.

Study I.

The limitations of Study I pertain to the use of the Critical Incident Technique and the shortcomings of reconstructive memory. However, this is a bias in all retrospect interviews. There is also a social desirability bias since most people think it is desirable to be perceived as creative. The methodology of the study could have been improved by asking participants to identify and describe incidents in which their creativity was hindered (cf. Amabile & Gryskiewicz, 1987) and by asking them to rate each critical incident on a scale that ranked the relative importance of the creative incidents.

Study II.

First, I argue that Cognitive Support and Knowledge Resources are, theoretically, antecedents of the LMX-MDM sub-dimensions. However, I cannot claim causality with our study design. Cognitive Support and Knowledge Resources may be antecedents of LMX, or vice versa. It is plausible that the variables interact and reinforce one another through processes of successful leader-member exchanges. Second, our predictor and criterion data were collected from one common source. However, we performed a modification of Harman's One Factor Test, which showed a low risk of common method variance. Third, Study II suffers from lack of power and would have benefited from sampling more participants.

Study III.

The first limitation pertains to the sample size. The study would have benefited from having sampled more groups and more group members from each group. The second limitation relates to the measure of creative performance. Publication measures may be measures of productivity rather than of creativity. We tried to study creativity from several perspectives. Apart from publication numbers, we also collected other measures of creative performance (i.e., patents, h-index) and subjective ratings of creativity. Unfortunately, these measures failed, resulting in a less integrative approach than intended. This is a shortcoming. By focusing on one isolated aspect of creativity, we risked overlooking other central aspects of the creativity phenomenon (Sternberg & Lubart, 1999). A more appropriate measure of creativity in commercial groups would have allowed more interesting inferences in the commercial research setting. Third, since leaders rated several followers, they may have generalized their relationships among the group members. This could challenge the validity of the leader ratings. Finally, it cannot be claimed that LMX influences creative performance since the design is cross-sectional. Moreover, the publications (dependent variable) were actually published before the LMX rating occurred. Many studies that investigate LMX and performance imply that LMX influences performance (Atwater & Carmeli, 2009; Scott & Bruce, 1994; Tierney et al., 1999), but other studies argue for the reverse effect (Bauer & Green, 1996; Liden et al., 1993).

Study IV.

As described in the limitations of Study III, there are also limitations related to the small sample size and the use of publications as measures of creativity in Study IV. Compared to Study III, Study IV evidences some additional attrition because of its longitudinal design. The lack of statistical power was particularly evident in the testing of Hypotheses 5 and 6 where one cell had as few as five subjects. Analyses would have benefited from a larger sample size. Moreover, in Study IV there is the problem of whether the follow-up data on future creative performance was collected with sufficient time delay to make claims of causality. It can be argued that the follow-up data was cross-sectional in a sense. The publications in the follow-up period may have been on their way to completion at the time of LMX data collection.

Concluding Summary

I studied leadership and creativity by including both leaders and followers in an examination of leadership and creativity in the four studies. I measured creativity subjectively (in Study I), bibliometrically (numbers of publications in Study III and Study IV), retrospectively (in Study III and Study IV), and prospectively (in Study IV). In Study I, we conclude that leaders are able to stimulate creativity by providing expertise and support to followers. In Study II, we suggest that leaders' provision of knowledge resources and cognitive support are two possible means for leaders to improve LMX quality. In Study III, we propose that leaders' ratings of the LMX relationship quality (rather than followers') are positively associated with creative performance in academic research settings. Study III also showed a negative predictive ability of LMX in commercial research settings, which revealed that the creative output measure was valued differently in the two settings. In Study IV, I found that the positive association between SLMX and creative performance in academic research groups was sustained over the substantial period of three years. I conclude that relationship quality as assessed by LMX should be measured from both leader and follower perspectives. Both Study III and Study IV show that SLMX ratings rather than MLMX ratings influence creative performance. However, only relationships of the highest possible quality (relationships where both leader and follower agree on the high quality of the relationship) are associated with followers' higher past creative performance (Study IV). This is consistent with theoretical assumptions but was not previously empirically tested in research settings (Elkins & Keller, 2003).

Historically, psychological research on creativity has emphasized individual traits and abilities in a way that might question whether it is possible to lead creative individuals or creative work. However, the claim of this thesis is that leaders can influence creativity in research (Study I, Study III and Study IV) and can influence followers' perceptions of the leader-follower relationship quality (Study II). Moreover, the claim is that leaders' perceptions of the leader-follower relationship quality, rather than followers' perceptions, are important to followers' creative research performance, measured as leaders' publications (Study III) and followers' publications (Study III and Study IV).

Implications

Although leaders are not the only influence on individual and group creativity, they do influence many components of creative performance in workgroups. According to the

findings in this thesis, leaders can and should try to influence follower creativity by taking a proactive stance in leadership, both regarding tasks and social work relationships. About 20% of the participants in Study I could not recall a single incident when their leader had stimulated their creativity. This finding indicates that group leaders may be too passive in their support of creativity in research settings. Given their formal roles, leaders have more responsibility for positive relationship developments than followers. I suggest that research leaders use their expertise to nourish their followers. This can be accomplished in a number of ways, with suitable rewards increasing their intrinsic motivation, delegating mundane or challenging tasks, or by provision of autonomy (Study I). Alternately, leaders can support followers' in research by providing them with knowledge resources and cognitive support (Study II), thus enabling followers to advance their projects and to develop their own abilities and expertise.

Moreover, to encourage creative achievements, I recommend that group leaders work to develop high quality relationships with followers in their groups (Study III), with high levels of leader follower agreement on the high quality (Study IV). This recommendation is consistent with the recommendations in the literature (e.g., Schyns & Day, 2010) and also with our findings (Study III). Moreover, leaders' ratings of high dyadic LMX quality may have a positive influence on followers' creative performance over several years (Study IV). In summary, since leaders' expertise and leaders' perspectives on LMX are influential on followers' creativity as well as on their own creative performance, research leaders should nourish their own expertise and strive to create high quality relationships with their followers. In that way, they set an example for followers while creating positive preconditions for work place creativity.

Future Research

It has been suggested that scholars of leadership research should incorporate leaders, followers, and relational as well as contextual variables in order for the field to advance (Avolio, 2007; Graen & Uhl-Bien, 1995; Hackman & Wageman, 2007). In their research on creativity, Sternberg and Lubart (1999) have suggested that creativity studies benefit from incorporating multiple disciplines and from studying the creativity phenomenon in a multi-faceted manner. Several scholars who have proposed integrative models or approaches creativity have argued the same point (Amabile, 1996; Csikszentmihalyi, 1999; Harrington,

1990; Hemlin et al., 2008; Mumford et al., 2002; Woodman et al., 1993). Recent network approaches on LMX (e.g., Goodwin, Bowler, & Whittington, 2009; Venkataramani, Green, & Schleicher, 2010) may be useful in testing more integrative and complex models of leadership and creativity. More research is also still needed to establish boundary conditions for when and how leaders can make a difference and when they cannot (Hackman & Wageman, 2007).

To date, the research has mainly emphasized the positive outcomes of LMX; future research could examine the more negative aspects of LMX. There is a gap in the research on the negative leadership behaviors that may influence outcomes at the team-member level in creative work (e.g., Denti & Hemlin, 2012a; Einarsen, Aasland, & Skogstad, 2007). Since low quality LMX relationships are suggested as detrimental to R&D team members' performance, creativity, and innovation (Elkins & Keller, 2003), more research is needed on the antecedents that negatively relate to LMX quality (see Schyns & Hansbrough, 2010; Shaw, Erickson & Harvey, 2011).

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Appendix 1

Items of follower-rated LMX (LMX-MDM; Liden & Maslyn, 1998)

Item
1. I like my supervisor very much as a person.
2. My supervisor is the kind of person one would like to have as a friend.
3. My supervisor is a lot of fun to work with.
4. My supervisor defends my work actions to a superior, even without complete knowledge of the issue in question.
5. My supervisor would come to my defense if I were "attacked" by others.
6. My supervisor would defend me to others in the organization if I made an honest mistake.
7. I do work for my supervisor that goes beyond what is specified in my job description.
8. I am willing to apply extra efforts, beyond those normally required, to meet my supervisor's work goals.
9. I do not mind working my hardest for my supervisor.
10. I am impressed with my supervisor's knowledge of his/her job.
11. I respect my supervisor's knowledge of and competence on the job.
12. I admire my supervisor's professional skills.

Note: Affect (items 1-3); Loyalty (items 4-6); Contribution (items 7-9); Professional Respect (items 10-12). Scale ranging from 1 (Strongly disagree) to 7 (Strongly agree).

Appendix 2

Items of leader-rated LMX (SLMX-MDM; Greguras & Ford, 2006)

Item
1. I like my subordinate very much as a person.
2. My subordinate is the kind of person one would like to have as a friend.
3. My subordinate is a lot of fun to work with.
4. My subordinate defends my decisions, even without complete knowledge of the issue in question.
5. My subordinate would come to my defense if I were "attacked" by others.
6. My subordinate would defend me to others in the organization if I made an honest mistake.
7. I provide support and resources for my subordinate that goes beyond what is specified in my job description.
8. I am willing to apply extra efforts, beyond those normally required, to help my subordinate meet his/her work goals.
9. I do not mind working my hardest for my subordinate.
10. I am impressed with my subordinate's knowledge of his/her job.
11. I respect my subordinate's knowledge of and competence on the job.
12. I admire my subordinate's professional skills.

Note: Affect (items 1-3); Loyalty (items 4-6); Contribution (items 7-9); Professional Respect (items 10-12). Scale ranging from 1 (Strongly disagree) to 7 (Strongly agree).

Appendix 3

Items Innovativeness (Hurley & Hult, 1998)

Item
1. Technical innovation, based on research results, is readily accepted.
2. Management actively seeks innovative ideas.
3. Innovation is readily accepted in program/project management.
4. People are penalized for new ideas that don't work.
5. Innovation is perceived as too risky and is resisted.

Note: Scale ranging from 1 (Not descriptive) to 7 (Very descriptive).