

POSITIVE AFFECT AND
PROJECT TEAM DEVELOPMENT AND EFFECTIVENESS

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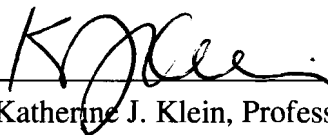
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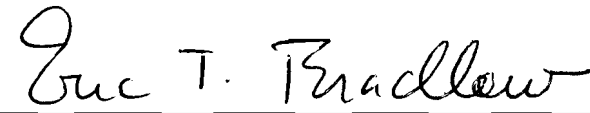
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Positive Affect and
Project Team Development and Effectiveness

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ABSTRACT

POSITIVE AFFECT AND PROJECT TEAM DEVELOPMENT AND EFFECTIVENESS

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In this dissertation I develop and test a conceptual model of how positive affect shapes project team development and effectiveness. Integrating and extending the literatures on positive affect and project team development, I propose that team trait positive affect—the relatively stable collective tendency for the members of a team to experience shared positive moods over time—aids in the development of three resources that research suggests are critical for project team effectiveness: team task routines, friendship network density, and team efficacy. Specifically, I suggest that team trait positive affect—a stable team “disposition” built from team members’ relatively homogeneous trait positive affect—shapes team developmental trajectories—the paths that a team takes in building resources over the course of its lifespan. Extending the literature on team development and effectiveness, I propose that team developmental trajectories with respect to task routines, friendship density, and team efficacy are key drivers of team performance. As such, I argue that positive affect indirectly shapes project team effectiveness by influencing patterns of team resource development over time. I find empirical support for key components of my conceptual model in a longitudinal survey-based study of 33 military teams preparing for and participating in a military competition. Team trait positive affect, my findings suggest, has important and significant effects on how teams develop over time, and furthermore, on team effectiveness. Indeed, while team trait positive affect relates to team effectiveness indirectly through its relationship with team developmental trajectories, the impact of team trait positive affect on team effectiveness is most clearly strong and direct. In total, my theory and my findings

suggest that team trait positive affect is a critical variable for understanding project team development and effectiveness.

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Introduction

The project team—a group of people assembled to generate a specific product, deliver a specific service, or accomplish a specific outcome within a delimited and typically short timeframe (Ericksen & Dyer, 2004; Gersick, 1988)—is a prevalent structure in organizations today (Keller, 2001). Managers often deploy project teams when a small group of people can complete an entire stream of work, deadlines are critical and defined, and continuity of collaboration is not needed once the job is complete. For example, software developers are often organized in project teams to engineer and produce a piece of software by its intended ship date. Similarly, new product developers are frequently organized in project teams and charged with generating a specific product within a delimited timeframe. In each example, a given team owns most if not all of the development process and there are high costs associated with failing to complete the job on time.

Scholars have for years grounded theory on team development—the path the members of a team together travel over the course of team life—in project teams. With their clearly defined start and end points, project teams are useful entities for thinking about and empirically researching team development. In the early years of team development theory and research, scholars (e.g., Tuckman, 1965) sought to describe the normative path traveled by most teams; that is, central tendency, or how a typical team developed, drove conceptual and empirical efforts. As the literature itself developed, however, scholars sought to identify consequences for team effectiveness—both positive and negative—of departing

from the “ideal” normative pattern of development; rather than central tendency, the consequences of variance in developmental patterns drove conceptual and empirical efforts (e.g., Jehn & Mannix, 2001; Kozlowski, Gully, McHugh, Salas, & Cannon-Bowers, 1996; Kozlowski, Gully, Nason, & Smith, 1999). Spurred by this theory and research, which suggests that development can impact project team performance, scholars (e.g., Ericksen & Dyer, 2004; Chen, 2005; Mathieu & Schulze, 2006; Mathieu & Rapp, 2009) have most recently turned their attention to explaining why some teams deviate from normative patterns of development in the first place; that is, the antecedents of departing from ideal developmental patterns are currently of particular interest to teams theorists and researchers. In contrast to the earliest goal of describing team development in general, a primary focus of contemporary theory and research on team development is thus figuring out why some teams develop well, resulting in high team effectiveness, while other teams develop poorly, resulting in low team effectiveness.

For years affective constructs (e.g., positive affect, affective culture), which represent how individuals and groups emotionally react and interact (Brief & Weiss, 2002), have played second fiddle to cognitive constructs (e.g., transactive memory systems, team mental models) in dominant theories of team development and performance (Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Ilgen, 2006). In their well-cited review of the teams literature, Guzzo & Dickson (1996) allocated just a single sentence to affect, moods, or emotions and, around the same time, Hinsz, Tindale, & Vollrath (1997, p. 58) asserted that “group performance researchers have generally ignored the role of emotions.” Encouraged, however, by a well-established psychological literature on affect and in step with a steadily growing literature on affect in organizational behavior (Barsade & Gibson, 2007; Barsade, Brief, & Spataro, 2003; Brief & Weiss, 2002), teams scholars are increasingly turning to affective constructs to understand what winds the clock of an effective team and makes it tick. Chief among the affective constructs teams scholars are beginning to embrace is positive

affect—a stable tendency for individuals (and groups) to experience positive, high-energy moods such as enthusiasm and excitement (Kelly & Barsade, 2001; Watson et al., 1988). Attesting to the changing role of affective constructs in the teams literature, and in stark contrast to Guzzo and Dickson's (1996) single sentence, Kozlowski & Ilgen (2006) devoted an entire section of their recent review of the teams literature to affect, highlighting *collective* conceptualizations of affect, moods, and emotions as an exciting area for conceptual and empirical work (p. 96).

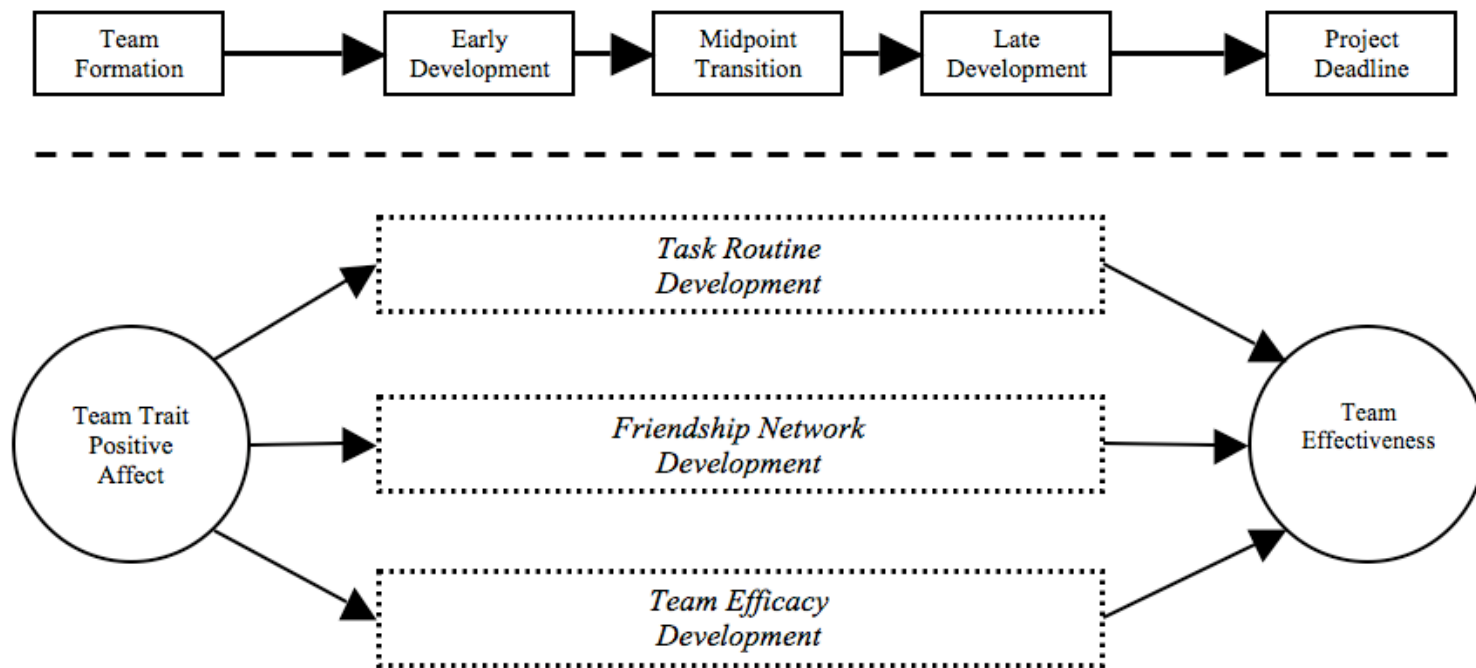
The findings from a burgeoning literature on positive affect in teams (e.g., Barsade, 2002; Barsade, Ward, Turner, & Sonnenfeld, 2000; George, 1990, 1995; George & Zhou, 2007; Gibson, 2003; Ilies, Wagner, & Morgeson, 2007; Totterdell, 2000; Walter & Bruch, 2008) and an expansive literature on positive affect at the individual level (see Lyubomirsky, King, & Diener 2005 for an exhaustive review) offer clues that the tendency for the members of a team to consistently share collective experiences of positive affect shapes project team development. The literature on the effects of positive affect at the individual-level is vast; in a recent review, Lyubomirsky et al. (2005) summarized the results of 225 papers that reported findings about the relationship between positive affect and outcomes ranging from creativity to social behavior to physiologic health. Research focusing specifically on positive affect in groups and teams, while more limited than research at the individual level, has similarly shown potent effects of positive affect on meaningful team outcomes. Shared experiences of positive affect are positively related to cooperation (Barsade, 2002), prosocial behavior (Mason & Griffin, 2005), creativity (Bramsfeld & Gasper, 2008; George & Zhou, 2007), and efficacy (Gibson, 2003), and negatively related to conflict (Barsade, 2002) and absenteeism (George, 1995; Mason & Griffin, 2003). While informative and promising, there is a dearth of theory regarding how positive affect shapes team development over time and, with few notable exceptions (e.g., Barsade, 2002; Totterdell, 2000), empirical research on positive affect in teams has been cross-sectional, precluding empir-

ical examinations of positive affect and change over time. We thus know very little about what role positive affect plays in project team development.

To fill these theoretical and empirical gaps and advance understanding of what drives effective patterns of project team development, I integrate the literature on positive affect with the literature on team development and propose a conceptual model of positive affect and project team development and effectiveness. Consistent with dominant theories of team development (e.g., Ilgen et al., 2005; Kozlowski et al., 1999; Marks et al., 2001), mine is an episodic model. That is, I conceptualize project team development as a series of interlocked phases, such that the outputs of one phase of development feed into the next phase and serve as inputs to subsequent developmental phases. Grounded in theory and research on positive affect at both the individual and team levels, I propose that positive affect aids a project team in developing critical team resources—assets that team members collectively draw upon in the course of their work—in three distinct, but related, areas: task resources, social resources, and motivational resources. More specifically, I suggest that frequent shared experiences of positive and high-energy emotions help a project team develop innovative and well-honed *task routines*—relatively stable patterns of coordinated task behavior that allow members to anticipate each others' actions and respond appropriately (Edmondson, Bohmer, & Pisano, 2001; Gersick & Hackman, 1990; Kozlowski, Gully, Nason, & Smith, 1999)—by influencing the extent to which a team engages in explorative search versus exploitative refinement over time. Shared positive affect also helps a project team, I suggest, develop an integrated and dense *friendship network*—a thick web of positive informal relationships among team members that facilitates communication and cooperative behavior (Balkundi & Harrison, 2006; Beal, Cohen, Burke, & McLendon, 2003; Jehn & Shah, 1997). Finally, I suggest that shared positive affect helps a project team develop high *team efficacy*—a shared perception held by team members that their team can perform its specific tasks effectively and efficiently (Gibson & Earley, 2007; Gully, Incalcaterra, Joshi,

& Beauieu, 2002). Extant theory and research on teams provides substantial evidence that these three resources are powerful drivers of team effectiveness (Kozlowski & Ilgen, 2006). Figure 1 presents my theory of positive affect and project team development and effectiveness.

Figure 1: Positive Affect and Project Team Development and Effectiveness



In developing and testing my conceptual model, I contribute to the literatures on positive affect and project teams, respectively, in several ways. First, my conceptual model integrates two relatively isolated bodies of theory and research: the literature on positive affect and the literature on project team development. This integration brings dynamism to the literature on positive affect in teams, which to date has been relatively static (Kelly & Barsade, 2001), and infuses with affect the literature on teams, which to date has been dominated by cognitive and demographic constructs (Barsade et al., 2000, 2003; Kozlowski & Ilgen, 2006). Second, my conceptual model adds to the limited, but growing literature on the development and origins of critical resources in project teams by explaining how shared affective experiences in teams shape resource development over time. Third, an empirical test of my model helps address a need identified by affect scholars (e.g., Barsade & Gibson, 2007; Bartel & Saavedra, 2000; Brief & Weiss, 2002; Kelly & Spoor, 2006; Lyubomirsky et al., 2005) and teams scholars (e.g., Ericksen & Dyer, 2004; Kozlowski & Ilgen, 2006) alike for longitudinal studies of how and why processes unfold in teams over time. Fourth, an empirical study of my model provides a direct examination of the often-assumed, but seldom-tested claim that developmental trajectories—the paths a team takes in developing resources over time—impact project team effectiveness (Ericksen & Dyer, 2004; Kozlowski et al., 1999; Marks et al., 2001). In total, my theoretical model and accompanying empirical test advance scholars' understanding of how affect—the way people feel—shapes how project teams develop over time.

I begin by presenting, defining, and explaining the core concepts of my theoretical model. After presenting these key terms and concepts, I describe how shared positive affect emerges at the team-level during project team formation. Next, I develop my conceptual model, depicted in Figure 1, and propose my hypotheses regarding how positive affect at the team level of analysis shapes the development of team task routines, team friendship network density, and team efficacy over time, thus indirectly influencing team

effectiveness. I then describe a longitudinal study of positive affect and team development and effectiveness in project teams preparing for and participating in a military competition. After presenting the results of my study, I discuss the implications of my conceptual model and empirical findings for theory and research on collective conceptualizations of positive affect, project team development, and team effectiveness.

Core Concepts

Affect across Dimensions, Time, and Levels

Scholars frequently distinguish between two basic dimensions of affect: positive affect and negative affect. Positive affect “reflects the extent to which a person feels enthusiastic, active, and alert,” whereas negative affect “is a general dimension of subjective distress and unpleasurable engagement” (Watson, Clark, & Tellegen, 1988, p. 1063). Although limited research does find effects for negative affect in groups (e.g., Cole, Walter, & Bruch, 2008; George, 1995; Sy, Côté, & Saavedra, 2005), there is far greater theoretical and empirical support for expecting positive affect, rather than negative affect, to play a key role in the development of project teams (Barsade et al., 2000; Barsade, 2002; Bramesfeld & Gasper, 2008; George, 1990, 1995; Gibson, 2003; Mason, 2006; Mason & Griffin, 2003, 2005). Barsade et al. (2000, p. 803) summarized their rationale for focusing on positive rather than negative affect in their study of top management teams, stating that “negative affect has been strongly related to more internalized states such as stress reaction, alienation, and aggression, as compared with the more externally oriented states of social closeness and social potency with which trait positive affect is related (Almagor & Ehrlich, 1990).” For similar theoretical and empirical reasons, I focus distinctly on the role of positive affect in shaping project team development and effectiveness.

In addition to distinguishing between positive affect and negative affect, scholars also typically distinguish between trait affect and state affect. Trait positive affect describes a dispositional tendency to experience frequent episodes of pleasant, energetic moods (Watson, 2002). Trait positive affect is a stable characteristic that persists across time; people high in trait positive affect tend to have relatively more positive experiences across situations compared to people low in trait positive affect, who tend to have relatively less positive experiences across situations (Watson et al., 1988). In contrast to trait positive affect, state positive affect describes shorter, more fleeting episodes of pleasant and energetic affective experiences (Barsade & Gibson, 1998). Episodes of state positive affect are driven in part by trait positive affect and in part by proximal situational stimuli (e.g., winning a raffle). On average, and across situations, high trait positive affect yields a relatively consistent frequency and intensity of state positive affect (Watson, 2002; Watson et al., 1988).

Finally, organizational scholars, especially, distinguish between different levels of analysis in conceptualizing positive affect. At the individual-level, positive affect describes one person's unique experiences of positive moods and emotions. Scholars (e.g., Arvey, Bouchard, Segal, & Abraham, 1989; Watson, Clark, & Tellegen, 1988) suggest that individual-level affect has genetic, developmental, and situational origins. At the collective-level, affective constructs describe the emotional properties or characteristics of a group, team, or larger organization—ranging from a team's or organization's holistic mood to the composition and diversity of a group with respect to group members' individual affect (Barsade & Gibson, 1998; Kelly & Barsade, 2001). Though some research has detailed the important role of diversity of affect in groups (i.e., the variance) (Barsade et al., 2000), most research on team-level affect has focused on and found interesting effects of a team's characteristic level of affect (i.e., the central tendency) (e.g., Barsade, 2002; George, 1990, 1995; Gibson, 2003; Mason, 2006; Mason & Griffin, 2003, 2005). George (1996, p. 78) reasoned, "If members of a group experience similar kinds of affective states at work, then

affect is meaningful not only in terms of their individual experiences, but also at the group level. The group has its characteristic kind of affect or affective tone.” Conceptualized as such, a team’s characteristic level of affect is a “shared” (Kozlowski & Klein, 2000) or “consensus” (Chan, 1998) construct; relative homogeneity among team members with respect to affect is necessary for the construct to be meaningful at the team level (George, 1990). Theorists suggest that team members may develop similar affective reactions for a number of reasons (George, 1996; Kelly & Barsade, 2001). First, due to attraction-selection-attrition processes (Schneider, 1987) the members of a team may have similar dispositions (e.g., individual trait positive affect), leading them to emote in similar ways (George, 1990, 1996). Second, due to the socially contagious nature of affect (Allport, 1924), team members may “infect” one another with their moods (Barsade, 2002; Bartel & Saavedra, 2000; Totterdell et al., 1998; Totterdell, 2000), leading to convergence in affect within the team over time. And, third, members may develop consistent affective reactions because during the course of their work they often encounter the same external stimuli (Weiss & Cropanzano, 1996; Ilies et al., 2007; Totterdell et al., 1998; Totterdell, 2000) or are governed by the same external norms regarding affective expression (Kelly & Barsade, 2001).

Crossing trait affect/state affect with individual-level/team-level affect yields four meaningful variants of positive affect in teams. I define and refer to these four constructs as follows. *Individual trait positive affect* (trait, individual-level) is an individual’s stable and enduring tendency to experience positive affective states over time (Watson et al., 1988). *Individual positive mood* (state, individual-level) is an individual’s positive affective state that is relatively short in duration and driven in part by individual trait positive affect and in part by proximal situational stimuli (Watson, 2002). *Team trait positive affect* (trait, team-level) is the relatively stable tendency for the members of a team to have shared experiences of positive affect over time (Kelly & Barsade, 2001; George, 1990). Team trait positive af-

fect is a team's "dispositional" positive affect and, as such, is relatively immutable over time (George, 1990). *Team positive mood* (state, team-level) is an emergent, shared, positive affective state at the team-level that is relatively short in duration and mild in intensity. Team positive mood is driven in part by team trait positive affect and in part by proximal situational stimuli (Barsade, 2002; George, 1995; Kelly & Barsade, 2001).

An Episodic Conceptualization of Team Development and Developmental Trajectories

An episodic conceptualization structures team development as a series of interlocked phases, cycles, or performance episodes. As teams develop they move through multiple stages that are linked, such that what occurs in one stage passes through to subsequent stages of development. In the past several years, episodic conceptualizations of team development have steadily gained prominence in the teams literature (Kozlowski & Ilgen, 2006), with theorists proposing a number of different frameworks: McGrath's (1991) time, interaction, and performance theory (TIP); Kozlowski et al.'s (1999) theory of team compilation; Marks et al.'s (2001) time-based theory of team processes; Ilgen et al.'s (2005) input-mediator-output-input (IMOI) model; and, most recently, Burke, Stagl, Salas, Pierce, and Kendall's (2006) input-throughput-output model. While there are differences among the episodic models that have surfaced in recent years (e.g., terminology, specified phases, focal levels of analysis), they share in common a few core features.

First, episodic conceptualizations are grounded in the familiar input-process-output (I-P-O) model of team development and effectiveness (McGrath, 1964), which specifies how teams transform inputs (e.g., team member characteristics, raw materials) through interdependent interactions (e.g., communication, coordination) to yield outputs (e.g., products and/or services, satisfaction). Episodic conceptualizations extend, however, the familiar

I-P-O model by treating team development as a series of multiple I-P-O phases that are interlocked, meaning that the outputs of one phase serve as the inputs to subsequent phases of development.

Second, theory and research viewing team development through an episodic lens suggests that there are four generalizable phases or episodes of project team development. During the *team formation phase*, team leaders or project managers select project team members, assembling and launching the project team. The team formation phase begins with the decision to put together a team to complete a specific task and ends with the complete formation of the team's membership (Ericksen & Dyer, 2004; Edmondson et al., 2001). The *early development phase* begins after team formation, when the team meets for the first time, and extends up to the temporal midpoint of a project team's lifespan. At this point, the team moves into the *midpoint transition phase* of development, a relatively shorter phase that occurs at approximately the temporal halfway point between a team's formation and the deadline for its deliverable. Research (e.g., Ericksen & Dyer, 2004; Gersick, 1988, 1989) suggests that the time surrounding the temporal midpoint is a critical period of team development. The final phase of team development, the *late development phase*, begins just after the midpoint transition phase ends and extends through the project deadline.

Across these phases of development, research suggests, teams follow different paths—what I refer to as *team developmental trajectories*—as they accumulate the resources needed to complete their tasks effectively (Edmondson et al., 2001; Ericksen & Dyer, 2004; Jehn & Mannix, 2001). A developmental trajectory with respect to a specific team resource, such as task routines or team efficacy, is made up of two components—where a team starts (i.e., the change intercept) and how the team changes with respect to the resource throughout team development (i.e., the change slope) (Chan & Schmitt, 2000; Chen, 2005; Hofmann et al., 1993).

Critical Team Resources: Task Routines, Dense Networks, and Team Efficacy

Three team resources are prominent in theory and research on project team effectiveness: task routines, friendship network density, and team efficacy (Kozlowski & Ilgen, 2006). These three resources, and more specifically how each resource develops over time, are similarly prominent in my conceptual model of positive affect and project team development and effectiveness.

Team task routines are repetitive and interdependent patterns or sequences of coordinated behaviors directed towards completing team tasks (Cohen & Bacdayan, 1994; Edmondson et al., 2001; Gersick & Hackman, 1990; Nelson & Winter, 1982). As an example of a team task routine, consider the intricate and interdependent dance of an emergency surgical team that is treating a critically injured patient. Specific members of the team, such as the nurse and the admitting physician, are responsible for enacting certain behaviors in a coupled sequence to provide the patient with initial care. In a well-honed team task routine, the nurses know what behaviors to expect from the physicians and when to expect them, and vice versa. The initial patient care routine ensures that a multi-disciplinary team delivers relatively efficient and error-free care (Klein, Ziegert, Knight, & Xiao, 2006). Team task routines such as this one implicitly govern the flow of work in teams and are critical mechanisms for storing interdependent task-specific knowledge (Cohen & Bacdayan, 1994; Nelson & Winter, 1982). Theory (Gersick & Hackman, 1990; Kozlowski et al., 1999) and research (Edmondson et al., 2001) suggest that the development of team task routines is particularly critical for project teams, which are assembled to accomplish a particular task within a specific window of time before disbanding. Team task routines ensure that project team members' interdependent behaviors are conducted and coordinated in an effective and efficient manner (Gersick & Hackman, 1990; Klein et al., 2006). Theory and

research (e.g., Cohen & Bacdayan, 1994; Gersick & Hackman, 1990; March, 1991; Nelson & Winter, 1982) suggest that to develop effective team task routines, the members of a team must both search for and discover novel approaches to team tasks and also refine those approaches to store the routine in the team's collective memory. Following March (1991), I refer to these two processes as, respectively, *exploratory search* and *exploitative refinement*. Exploratory search describes a set of behaviors, such as questioning assumptions and trial-and-error experimentation, oriented towards discovering new ways of completing team tasks. Exploitative refinement describes a set of behaviors, such as rehearsing or practicing a set of behaviors or making incremental improvements to an already-known solution, oriented towards storing a team task routine in collective memory.

Team friendship density is a characteristic of the pattern of informal interpersonal, positive relationships among the members of a team. Network density indicates the relative connectedness of a team, or the extent to which relationships are formed among team members; in a team with maximum network density, each member is connected to or has a relationship with each other team member (Wasserman & Faust, 1994). Among the different types of informal relationships in teams—advice, friendship, and conflict relationships, for example—research to date indicates that a dense network of informal friendship ties is particularly important for facilitating team effectiveness and viability [see Balkundi & Harrison (2006) for a review and meta-analytic evidence]. A dense friendship network, in which most if not all members of a team are friends with one another, enhances cooperation, communication, and commitment to the team (Balkundi & Harrison, 2006; Jehn & Shah, 1997). For project teams, which are often composed of unfamiliar team members at the start (Keller, 2001), the development of dense friendship networks over time is of particular importance.

Team efficacy refers to team members' shared perceptions of team capabilities and, in particular, members' shared confidence that their team can accomplish its tasks in an effec-

tive manner (Gibson, 1999). A substantial body of empirical research indicates that team efficacy is significantly, positively related to team performance [see Gully et al. (2002) for a review and meta-analytic evidence]. Teams high in efficacy, theory and research suggest, set high goals, persist in the pursuit and completion of those goals, and overcome adversity throughout goal-directed activity (Bandura, 1997). For project teams, which have a very specific goal and deadline, team efficacy is especially critical for driving high performance (Gibson & Earley, 2007; Kozlowski et al., 1999).

Fredrickson's Broaden-and-Build Theory of Positive Emotions

In describing how team trait positive affect helps teams accumulate resources over the course of their development, an emerging individual-level theory—Fredrickson's "broaden-and-build" theory of positive emotions—serves as a useful analogue. In her theory, Fredrickson (2001, p. 224) proposes that "positive emotions are vehicles for individual growth and social connection" that contribute to human flourishing. Fredrickson's theory has two fundamental components. First, drawing from extensive research on the effects of positive affect at the individual level, Fredrickson (1998, p. 315) argues that positive affective states stimulate people to have "broadened thought-action repertoires." That is, positive moods and emotions widen the scope of alternatives that people consider in approaching cognitive problems and lead people to respond to life situations with flexible mindsets. Supportive empirical findings for this component of the theory are prevalent throughout the literature on individual positive affect (Lyubomirsky et al., 2005) and, additionally, Fredrickson and her colleagues have found support in a series of laboratory experiments (Fredrickson & Branigan, 2005; Bramesfeld & Gasper, 2008).

The second fundamental component of Fredrickson's theory—the "building" component—suggests that the momentary benefits of broadened mindsets accumulate over time, compounding into stable intellectual and social resources. As such, the theory predicts, people

predisposed to experience frequent positive moods and emotions are more likely than less positive others to build these types of stable resources. Empirical research on this component of the theory is currently limited, due in part to the practical challenges associated with collecting longitudinal data that tracks the development of resources over time. However, in a recent laboratory study, Fredrickson and her colleagues (Fredrickson et al., 2005) induced positive affect on a daily basis for a month in a sample of students and found that those so induced exhibited increasing resilience over time. Thus, although limited, evidence for the “building” component of the theory is promising.

Despite focusing exclusively on the individual level, Fredrickson’s broaden-and-build model is a useful analogue for framing the effects of team trait positive affect on the accumulation of team resources across the intertwined phases of project team development. Adopting a “broaden-and-build” lens at the team-level, the outputs of frequent episodic experiences of team-level (i.e., shared) positive moods, make steady, incremental contributions to team resources, which subsequently become the inputs to further phases of development. Through a broaden-and-build mechanism, these incremental contributions accumulate and compound over time into stable team resources.

In my model of positive affect and project team development, I blend the core ideas of Fredrickson’s broaden-and-build theory—that the tendency to experience positive emotions helps steadily build resources over time—with a view of team development as a series of intermeshed phases. As I explain in detail below, I propose that team trait positive affect—the stable tendency for a team to experience frequent instances of more short-term positive moods—broadens a team’s approaches to its tasks, its membership, and its capabilities and that over time and across phases of development the results of repeated broadening compound into innovative and well-honed team task routines, dense friendship networks, and high team efficacy. Before describing the development of each of these resources over time, I first explain how team trait positive affect emerges during the formation phase of

project team development.

Positive Affect and Team Resource Development

The Emergence of Team Trait Positive Affect during Team Formation

Team formation is the period “between project initiations and team launch meetings . . . during which, at a minimum, team members are identified and recruited” (Ericksen & Dyer, 2004, p. 439). Theorists (e.g., Hackman, 1987) and researchers (e.g., Edmondson et al., 2001; Ericksen & Dyer, 2004) have highlighted team formation as a valuable leverage point for project team leaders and managers; during formation leaders can work to assemble team members who collectively comprise the knowledge, skills, and abilities needed to complete the project successfully. In their qualitative, grounded theory-building study of project teams, Ericksen & Dyer (2004, p. 452) adopted an episodic conceptualization of team development and noted that “because team leaders chose their own members, team composition (or design) can logically be seen as an output of the mobilization or launch phase.”

One facet of team composition that until recently teams scholars have largely neglected (Barsade et al., 2000; Kozlowski & Ilgen, 2006) is composition with respect to team members’ affective dispositions. Kelly & Barsade (2001) described team members’ affective dispositions as important bottom-up building blocks of team-level affect, such that a team’s affective composition is one determinant, in addition to more top-down drivers (e.g., emotional display norms) of team-level affective experiences. And, indeed, in some of the earliest work on collective affect in workgroups, George and her colleagues (George, 1990, 1996; George & Brief, 1992) argued that composition with respect to team members’ trait affect is instrumental in shaping team-level affective experiences. And, after finding homogeneity in group members’ individual trait affect in a study of sales organizations, George

(1990) used team composition with respect to member trait affect to operationally define team trait positive affect, an approach I also take.¹ In addition to George's early empirical research (e.g., George, 1990, 1995), more recent studies of groups and teams have found significant homogeneity among team members in dispositional affect (e.g., Bartel & Saavedra, 2000; Cole et al., 2008; Gibson, 2003; Ilies et al., 2007; Mason & Griffin, 2003, 2005; Sy et al., 2005). Replicating this research, I hypothesize:

Hypothesis 1: Project teams are homogeneous in team members' trait positive affect.

How, though, does a group or team come to be composed of people with similar affective dispositions? George (1990, 1996) posited that relative homogeneity or consistency in team members' trait affect stems from evolutionary dynamics consistent with Schneider's (1987) attraction-selection-attrition (ASA) model. In brief, Schneider's (1987) ASA model is an evolutionary process model that describes how similarity-attraction effects (e.g., Byrne, 1971) push organizations towards homogeneity with respect to members' values, beliefs, and dispositions. According to Schneider, organizations become homogeneous in members' traits because (a) individuals are attracted to join organizations to which they feel similar, in terms of personality; (b) recruiters tend to select candidates for organizational membership whose personalities fit the organization's culture; and, (c) people whose personalities are most dissimilar from others in the organization are at highest risk to turnover, leaving behind an increasingly homogeneous group. Together and over time, the processes of attraction, selection, and attrition yield an organization composed of people who have relatively similar personalities. Empirical research has largely supported Schneider's theory (Bretz, Ash, & Dreher, 1989; Giberson, Resick, & Dickson, 2005; Jack-

¹George (1990, 1996) referred to a group's tendency to experience a relatively consistent level of positive moods and emotions over time as positive affective tone. As describe above, for clarity, I adopt the term "team trait positive affect" to refer to this construct in my theory, which crosses levels and time.

son et al., 1991; Ployhart, Weekley, & Baughman, 2006; Schaubroeck, Ganster, & Jones, 1998; Schneider, Goldstein, & Smith, 1995; Ziegert & Schneider, 2004).

Trait positive affect is one personality characteristic, George (1990) suggested, that potential organizational members and recruiters use to judge similarity and, thus, trait positive affect is one characteristic that may drive the ASA cycle in groups and teams. Unlike large organizations, however, that employ recruiters to staff relatively long-standing departments and workgroups, a short-term project team's membership is often driven by the formal project leader (Edmondson et al., 2001; Ericksen & Dyer, 2004; Hackman, 1987). Team leaders are responsible for identifying potential team members and potential team members also may volunteer their services to a team leader for a project of particular interest. Project team formation is thus a matching process between team leaders, who are actively searching for high quality team members, and prospective team members, who are actively searching for a high quality team experience.

Theory (e.g., Barsade et al., 2000; Byrne, 1971; George, 1996; Schneider, 1987) and research (e.g., George, 1990, 1995) suggest that potential team members' attraction to a project team and a team leader's selection of team members is driven, in part, by similarity in trait positive affect. Barsade et al. (2000) extended Byrne's (1971) similarity-attraction theory and suggested that, much like people prefer to interact with others who hold similar values or beliefs, similarity in affective disposition is pleasurably reinforcing. That is, interacting with affectively similar others validates one's affective or emotional approach to the world, thus reinforcing this approach (Barsade et al., 2000); in short, positive people validate one another's positivity, while misery love company. Because the project team leader is often an instrumental and public figure in project team formation (Edmondson et al., 2001; Ericksen & Dyer, 2004), the similarity between the formal team leader's individual positive affect and prospective team members' individual positive affect may influence the attraction and selection pieces of the ASA cycle for project teams (George, 1990, 1996).

With the prominence of the project team leader, homogeneity in project team members' individual positive affect may stem from individual team members' differential attraction to and selection by the team leader based on affective fit. If so, team trait positive affect—a team's composition with respect to members' trait positive affect—is, in part, a function of the team leader's trait positive affect. Accordingly, I hypothesize:

Hypothesis 2: Leader trait positive affect is positively related to team trait positive affect.

Consistent with the definition of team trait positive affect as a stable, disposition-like construct, team positive mood—the more short-term type of affective experience—is likely relatively consistent across project team life. Homologous to findings at the individual level, which indicate that individual trait positive affect is positively related to a relatively stable level of positive affective experiences across time (e.g., Staw & Ross, 1985; Staw, Bell, & Clausen, 1986; Watson, Clark, & Tellegen, 1988), teams high in team trait positive affect, by definition, should experience relatively consistent high positive moods across team life, while teams low in team trait positive affect should experience relatively consistent low positive moods. As such, I offer two hypotheses regarding the nature of the construct of team trait positive affect as I have defined it. Specifically, to verify that team trait positive affect is a disposition-like construct at the team-level, I examine the stability of team positive mood over time and the relationship between team trait positive affect and team positive mood. The following two hypotheses, in combination, are essential for verifying the nature of the construct as a disposition-like construct at the team-level:

Hypothesis 3: Team positive mood is relatively consistent across phases of project team development.

Hypothesis 4: Team trait positive affect is positively related to team positive mood across phases of project team development.

Team Trait Positive Affect and the Development of Task Routines over Time

The development of task routines in project teams—the process through which teams build interdependent patterns of behavior to complete their tasks—is a process of variation, selection, and retention (Gersick & Hackman, 1990; Gibson & Vermeulen, 2003). Over the course of its lifespan, a project team must (a) generate raw knowledge and ideas about how it can best complete its tasks (i.e., variation); (b) select the most promising and most feasible of these ideas given the characteristics of the team and the nature of its tasks (i.e., selection); and, (c) refine, codify, and implement those routines that are selected as viable solutions (i.e., retention) (Gibson & Vermeulen, 2003, p. 205-206).

As I detail below, I propose that team trait positive affect, through its broadening effects on team members' perspectives, aids a team in building stable team task routines over time. More specifically, I suggest that teams high in team trait positive affect follow an optimal developmental trajectory of variation, selection, and retention over time. From early development to the midpoint transition, I propose, teams high in positive affect openly and effectively search in an exploratory way for innovative solutions. At the critical midpoint, teams high in positive affect satisfice as they determine which of the ideas and solutions that they have generated are viable solutions for their tasks. Having found and selected viable routine components, these teams close down learning-focused activities as the project deadline approaches during late development and, instead, focus their efforts and attention on refining the approaches that they have to date discovered. Teams low in team trait positive affect, on the other hand, follow a sub-optimal developmental trajectory. These teams, I argue, struggle to search effectively to generate viable routine components from early development to the midpoint transition; fail to select routines at the midpoint for further development; and, thus, they approach the project deadline during late development

without refined and stored task routines. Before describing this process, however, I briefly outline a useful metaphor for envisioning task routine development over time: The fitness landscape.

The Fitness Landscape as a Metaphor for Project Team Routine Development

The fitness landscape, developed in biology but imported into the organizational adaptation and learning literature (Levinthal, 1997), is a useful metaphor for visualizing the development of task routines in project teams over time. In the organizational sciences, theorists (e.g., Knudsen & Levinthal, 2007; Gavetti & Levinthal, 2000; Levinthal, 1997) have used the fitness landscape as a model for how multiple characteristics of an organization interact to affect the degree of fit between the organization and its overarching context. While the model has a number of nuances, a few core aspects are particularly relevant for envisioning the process of team task routine development over time.

The nature and picture of the landscape itself, with its single global peak, multiple local peaks, and many valleys, is a useful way to think about the variety of options that a given project team might have for completing its tasks. The elevation at any point on the fitness landscape represents the degree of fitness between a project team's approach(es) to its tasks. A project team moves throughout the landscape with a goal of maximizing this fitness; in essence, a project team is trying to constantly climb to the top of the landscape. This top point—the single, global peak on the landscape—represents the absolute best way that a project team, given its characteristics (e.g., membership, resources), might accomplish its tasks. For a project team, which is frequently composed of people unfamiliar to one another before the start of the project (Keller, 2001), the best way is ambiguous and difficult to determine at the start, if ever.

In addition to the nature of the landscape, is the nature of movement throughout the landscape; or, how a project team moves through the peaks and valleys in search of op-

timal ways of completing its tasks. Organizational theorists (e.g., March & Simon, 1958; March, 1991; Nelson & Winter, 1982; Levinthal, 1997) distinguish between two main types of movement or change in an organization's approach to its tasks. In the first type, an organization moves dramatically from one part of the landscape to another, long jumping in search of the global peak. I refer to this type of movement across the landscape as *exploratory search*. For a project team, exploratory search is a process of trying out new techniques, new ideas, new solutions, and new approaches to interdependent interactions to effectively complete its tasks. In the process of task routine development described above, exploratory search drives variation

In the second type of movement across a landscape an organization moves slightly and continuously along its existing course, hill climbing in search of the peak of its current location on the landscape. I refer to this type of movement across the landscape as *exploitative refinement*. Exploitative refinement, this process of incrementally honing interdependent actions and approaches, is critical for storing task routines in project teams (Gersick & Hackman, 1990; Gibson & Vermeulen, 2003) and extracting value from the results of exploratory search (March, 1991). In the process of task routine development described above, exploitative refinement drives retention of interdependent task routines.

From early development to the midpoint transition: Generating variety through exploratory search

The first step in building team task routines, and normatively a primary focus of taskwork in the early stages of project team life, is variation; during early development team members gather information and experiment with different approaches for completing their tasks (Ericksen & Dyer, 2004; Gersick, 1988; Kozlowski et al., 1999). Project team scholars (e.g., Gersick, 1988) have noted that it is common for many teams to show relatively little appreciable progress in taskwork during the early development phase. Rather than solidifying

team plans and project strategies in formal documents, procedures, and stable or defined team task routines, team members' efforts during early development are best-spent, so suggest teams theorists, on broad searches for the raw background information and ideas that will only later become refined task routines.

Some teams are better at experimentation, idea generation, and the exploratory search for solutions than others (Edmondson, 1999; Edmondson et al., 2001; Wong, 2004); some teams are better at long jumping across the fitness landscape with ease. An integration of the literature on positive affect and creativity with the literature on exploratory team learning suggests that, by broadening team members' approaches to task problems, team trait positive affect may enhance a team's ability to generate raw, creative solutions and ideas—the initial building blocks of team task routines—during the early development phase. While a few recent laboratory experiments (Bramsfeld & Gasper, 2008; Grawitch, Munz, & Kramer, 2003) have shown that groups induced to experience positive moods generate a higher quantity of creative ideas than either neutral or negative mood groups, the mechanisms behind the relationship between positive affect and variety-production at the team-level remain ambiguous (Amabile, Barsade, Mueller, & Staw, 2005).

A long history of theory and research on positive affect at the individual-level, however, provides intriguing clues as to why team trait positive affect—a team's collective, dispositional positive affect—may facilitate creativity and variety production especially during the early development phase in project teams. Scholars (e.g., Fredrickson, 1998; Lyubomirsky et al., 2005) argue that positive affect generates creative thought in individuals by driving exploratory behaviors, broad searches for novel solutions, and a general broadening of individual cognition. Isen (1999) proposed that positive affect broadens cognition specifically by making accessible a large quantity of heterogeneous information and increasing the complexity with which individuals process this diverse information. Fredrickson (1998, 2001) further argued that positive affective experiences breed flexibility and experimenta-

tion by making people feel safe to take risks, act and think playfully, and proactively explore their environments. A number of laboratory and field studies, using a diverse range of measures of creativity, provide support for a positive relationship between positive affect and individual variety-production. For example, in two experiments using a word association test to measure creativity, Isen and her colleagues (1985) found that inducing positive affect in college students led them to generate significantly more unique word associations than students who did not receive the induction. And, in a recent study of creativity in the workplace, Amabile et al. (2005, p. 390) analyzed employees' daily diary accounts of their work and found "consistent evidence of a positive relationship between positive affect and creativity." These two examples are just a thin slice of a large empirical literature that provides support for a relationship between positive affect and variety production at the individual level. Based on their meta-analysis of 102 effect sizes of the relationship between mood and creativity at the individual-level, Baas, De Dreu, & Nijstad (2008) concluded, "In general, positive moods produce more creativity than do mood-neutral controls." Lyubomirsky et al. (2005) reached the same conclusion based on a qualitative review of nearly 60 effect sizes of the relationship between positive affect and creativity.

Yet, while individual creative thoughts and ideas are a necessary component of collective variation in project teams, alone they are insufficient. For individual creative thoughts to contribute to team-level exploratory search and variation—the first piece of building team task routines—team members must communicate those thoughts with one another through what team learning scholars (e.g., Edmondson, 1999; Edmondson et al., 2001; Gibson & Vermeulen, 2003) refer to as team learning behaviors. Team learning behaviors, which are the manifestation of an exploratory search orientation at the team-level, are actions such as public exploration, experimentation, and communication about novel ideas that spread individual creative thoughts throughout the team (Edmondson, 1999). Organizational learning theorists (e.g., Argyris & Schon, 1996; Edmondson, 1999; Edmondson

et al., 2001; Gibson & Vermeulen, 2003) suggest, and empirical research supports (Edmondson, 1999; Edmondson et al., 2001), that team members are most likely to engage in this type of public exploratory search when they feel comfortable taking interpersonal risks and exposing themselves in an unguarded way to possible failure or just the simple embarrassment of being wrong.

Team trait positive affect is one attribute likely to bolster feelings of safety and comfort among team members, thus increasing the likelihood that they take the interpersonal risks needed to produce team-level variety through exploratory search. There are at least three reasons why team trait positive affect is likely to have this effect. First, theory and research suggest that people interpret positive moods and emotions as signals that their environment is, in general, safe (Fredrickson, 1998; Schwartz, 2000). Because teams high in team trait positive affect experience consistently positive moods, a general sense of security is likely to pervade team interactions. These collective feelings of safety make it easier for team members to engage in exploratory search and team learning behaviors (Edmondson, 1999). Such feelings of safety are likely to be less prevalent in teams low in team trait positive affect, where positive moods occur with less frequency and intensity. Second, and relatedly, theory and research suggest that positive affect helps people cope with negative events (Aspinwall, 1998; Fredrickson, 2001). Team trait positive affect may in this way provide a buffer within teams to the potentially negative feelings that can arise when novel ideas or innovative approaches to team tasks fail to work. The members of a team high in team trait positive affect are likely less discouraged by failed ideas and more likely to persist in experimentation than members of a team low in team trait positive affect (Adler & Obstfeld, 2007). Third, theory and research suggest that positive affect is positively related to communication among group members (Forgas & George, 2001) and, in particular, to communication about unconventional or novel topics (Forgas, 1999). Accordingly, in a rather direct way, team trait positive affect likely stimulates team members to engage

in exploratory search through team learning behaviors, publicly experimenting and communicating with one another about new ways of approaching team tasks and interactions. Because of these effects, project teams high in team trait positive affect are more likely than project teams low in team trait positive affect to engage in frequent exploratory search during the early development phase of team life. Accordingly, I hypothesize:

Hypothesis 5: Team trait positive affect is positively related to exploratory search during the early development phase of project team life.

From the midpoint transition through late development: Selecting and retaining promising ideas through exploitative refinement

Project team theorists (Gersick, 1988; Kozlowski et al., 1999) have noted that the midpoint transition phase of team development is a time during which team members should, and often do, reflect intensely on task-based concerns. Indeed, the temporal midpoint has been a time of particular interest for project team theorists and researchers (e.g., Gersick, 1988, 1989). The midpoint of project team life serves as a natural and salient signpost—an “alarm clock” (Gersick, 1988, p. 34)—for team members that they are steadily consuming their temporal resources. Research shows that team members, normatively, heighten their task focus during the midpoint transition as they work to make sense of their progress to date and of the road ahead (Ericksen & Dyer, 2004; Gersick, 1988, 1989). Driven by the pressure of their magnified timeline, team members often work during the temporal midpoint to narrow down the range of ideas, approaches, and potential solutions that they generated throughout the early development phase to determine how, in the remaining half of their time, they will implement their ideas and refine interdependent routines to complete their tasks. Rather than variation, which is a focal activity during early development, the selection and retention components of the task routine development process become critical at

the midpoint and throughout late development; project teams must identify and store those ideas that are most promising and discard those ideas that are not.

On the surface, the broadening effects of team trait positive affect might seem most likely to hinder the selection of promising ideas during the midpoint transition. Recent theory (Schwartz, 2000) and research (Schwartz et al., 2002) on maximizing and satisficing behavior, however, suggest counterintuitively that team trait positive affect may in fact help project teams select promising ideas, shift their focus to refining rather than innovating, and altogether move forward in the routine development process. Maximizing refers to seeking out “the best possible outcome regardless of the cost in time or effort” (Lyubomirsky et al., 2005, p. 831), while satisficing refers to “looking for something that is good enough” (Schwartz et al., 2002, p. 1179). Schwartz et al. (2002) proposed that a tendency to maximize or satisfice when faced with choosing from a set of options is an individual difference that is related to positive affect. Specifically, Schwartz et al. (2002) hypothesized that positive affect is negatively related to maximizing because people who maximize are likely to feel regret when they eventually do make a decision. Maximizers, who seek the absolute best possible option, are likely to struggle to reach closure in decision problems, the best solution to which is often impossible to determine with the available information. Although they framed causality as running from maximizing to positive affect, such that maximizing behavior is negatively related to positive affect, Schwartz et al. (2002, p. 1195) acknowledged compelling reasons that causality might flow in the opposite direction such that people in low in positive affect “continually strive to make ‘better’ choices and judgments, in an ultimately fruitless effort to enhance their happiness.” In an initial scale development study (i.e., to validate an individual-level survey measure of maximizing), Schwartz and his colleagues (2002) found significant, negative relationships across a number of studies between maximizing on the one hand, and positive affect, moods, and emotions on the other.

In addition to this more recent line of work on the relationship between positive affect and satisficing, a rich literature on positive affect and decision-making similarly suggests that team trait positive affect might help the members of a project team select promising ideas during the midpoint transition. Isen and her colleagues (e.g., Isen, 2000; Isen & Baron, 1991; Isen, 2001) laboratory studies on the impact of positive affective experiences on decision-making quality and efficiency indicate that when people feel positively, they effectively adapt their decision-making approach to the needs of the situation. When decision-making situations explicitly require efficient processing of information—such as when there is time pressure—people induced to feel positively come to a decision faster than do those who are not so induced (Isen & Baron, 1991; Isen, 2001). Isen’s research suggests that when people feel positively, they are more aware of and attuned to the nuanced needs of their tasks and situations and adjust their decision-making approach accordingly.

In project teams, with their clearly defined deadline, the temporal midpoint serves as a salient signal for team members of the costs—both in time and effort—of engaging in exploratory search and making long jumps looking for the best way to complete team tasks, as opposed to engaging in exploitative refinement and climbing to the top of the hill or hills that they have already found. Gersick (1988, p. 34) concluded from a qualitative, grounded theory-building study of project teams that the midpoint serves this function because “halfway is a natural milestone, since teams have the same amount of time remaining as they have already used, and they can readily calibrate their progress.” Scholars (e.g., Ancona, Okhuysen, & Perlow, 2001) suggest that people often view time, like money, as an expendable resource; time spent in one endeavor necessarily means time is taken away from another. For example, in a product development team, the more time that team members spend on preliminary market research, the less time members have available to test product prototypes. This temporal tension—between exploratory search and exploitative refinement of selected solutions—is similar to March’s (1991) classic distinction between

exploration and exploitation. In the case of project teams developing interdependent task routines, however, a middle-ground step between broad exploratory search and the exploitation of interdependent routines is essential; teams must select, refine, and ingrain in their collective memory interdependent routines before they can be exploited (Cohen & Bacdayan, 1994; Gersick & Hackman, 1990).

I propose that as the temporal midpoint activates and heightens the salience of the project timeframe, teams high in positive affect are more likely to satisfice than maximize, selecting for exploitative refinement effective ways to complete their tasks from the pool of ideas and options generated during the early development phase, for several interrelated reasons. First, as I hypothesized above, teams high in team trait positive affect are likely to have a larger and more heterogeneous pool of potential ideas from which to choose; during early development such teams have explored a broad swath of the landscape. Having a larger and more diverse option set increases the likelihood that the team has indeed discovered viable solutions and patterns of interdependent behavior for completing its tasks effectively. Second, through its broadening effects (Fredrickson, 1998), team trait positive affect likely widens team members' perceptions of the viability of the options that they have accumulated throughout the early development phase. Members of teams high in team trait positive affect are thus more likely to evaluate the option set in a positive manner than are members of teams low in team trait positive affect. Third, and related, Schwartz and his colleagues' (Schwartz, 2000; Schwartz et al., 2002) theory and research suggest that teams high in team trait positive affect are likely to be composed of satisficers, while teams low in team trait positive affect are likely to be composed of maximizers. Individually, these satisficers are more likely to settle on and accept solutions than are maximizers. Fourth, Isen and her colleagues' (Isen, 2000) program of experimental research on positive affect and decision-making suggests that the members of teams high in positive affect are likely to be especially attuned to the changing needs of their decision-making tasks as the tem-

poral context surrounding their work changes, adjusting their approaches accordingly and making decisions in an efficient way at the midpoint.

Together, these four effects—the size and diversity of the available option set, the flexibility with which team members perceive their options, the degree to which team members individually maximize or satisfice, and the efficiency with which team members make decisions—likely have a powerful impact on the trajectory of task routine development in project teams. In teams high in team trait positive affect, I suggest, the option set is large and rich, evaluative approaches are flexible, and members are content with solutions that, though perhaps not the best, get the job done. Viewing the ideas that they generated during early development as an acceptable set of potential solutions, members of teams high in team trait positive affect likely decrease time spent on exploratory search—public experimentation with new ways of doing things and communication especially about novel events or methods—following the midpoint transition phase of team development. In teams low in team trait positive affect, on the other hand, the option set is small, evaluative approaches are relatively rigid, and team members feel compelled to find the absolute best way of completing their tasks. Frequently, unable to identify the best way of completing their tasks, however, these teams likely persist in a never-ending search even as the project deadline approaches; insufficient variety during early development combined with members' tendency to maximize outweighs the pressure of the salient temporal midpoint.

Following the temporal midpoint and throughout the late development phase that precedes the project deadline, I thus propose that teams high in team trait positive affect shift their attention away from variation to retention—away from exploratory search and to exploitative refinement—in the task routine development process. Refining and collectively storing interdependent task routines (e.g., a workflow for software code writing and debugging in a software development team) requires repetitive behavior, accompanied by small, incremental changes to selected ideas (Cohen & Bacdayan, 1994; Gersick & Hack-

man, 1990). Time spent exploring for new ways to accomplish team tasks or coordinate team activities at this point in team life is necessarily time taken away from practicing, rehearsing, or learning-by-doing an already-selected approach. As such, compared to teams high in team trait positive affect, teams low in team trait positive affect likely struggle as the project deadline approaches during late development to hone and refine interdependent task routines; rather than adopting and repeatedly using a given approach, they continue to spend time trying out different approaches. Teams high in team trait positive affect, on the other hand, ramp down exploratory search behavior following the temporal midpoint and instead spend their time implementing and refining selected interdependent routines and ideas that they have selected, engraining these approaches in the teams' collective task routine repertoire. Formally, regarding the trajectory of task routine development over the course of team life, I hypothesize:

Hypothesis 6: Team trait positive affect is negatively related to growth in exploratory search over the course of project team life.

Hypothesis 7: Team trait positive affect is positively related to growth in exploitative refinement over the course of project team life.

Summarizing my predictions regarding the role of team trait positive affect in the development of task routines over time, I propose that team trait positive affect enhances variety production during the early development phase, aids in the selection of viable alternatives during the midpoint transition phase, and thereby enables a team to close down exploratory search and focus instead during the late development phase exploitative refinement—implementing and retaining selected ideas and approaches in collective memory. In each phase, the broadening effects of team trait positive affect generate certain outputs—raw ideas, selected ideas, and refined routines—and these outputs compound into stable task routines over time as the outputs of one phase of development serve as the inputs

for subsequent phases. A multitude of raw ideas at the conclusion of the early development phase serves as the option set for idea selection during the midpoint transition phase. And, selected ideas from the midpoint transition phase serve as the ideas that are refined during the late development phase.

Team Trait Positive Affect and the Development of Friendship Network Density over Time

In project teams, team members often do not know one another personally prior to working together (Keller, 2001). And yet, even before meeting one another in early team meetings, team members may receive information about who is going to be on the team. Depending on organizational context and the nature of the project, team members may know of other team members through their reputations despite not knowing them personally. With even limited information in hand, members likely begin forming initial impressions of their fellow teammates as potential friends as soon as they join a team (Norman & Goldberg, 1966). These initial impressions and perceptions are modified and adjusted over time, however, as team members gain direct information about one another and as they share events and experiences with one another (Harrison, Price, & Bell, 1998; Newcomb, 1961). Together, these two components—how team members initially view friendship relations with one another and the change over time in these perceptions—form a project team’s developmental trajectory with respect to team friendship network density.

As I describe in detail below, due to how positive affect shapes interpersonal perception, team trait positive affect may increase the likelihood that team members become friends initially. And, furthermore, due to reciprocal dynamics between positive affect and positive social relationships, team trait positive affect may kick off a virtuous cycle of growth in friendship relationships within the team that extends throughout team development. Be-

cause individual friendship relations are the building blocks of team network density—mathematically an aggregation or summary of how connected a network is (Wasserman & Faust, 1994)—a team high in team trait positive affect may thus develop a friendship network that increases in density over the course of project team life, while the friendship network of a team low in team trait positive affect may stagnate at best and fall apart at worst.

Initial friendship network density during early development

People high in individual positive affect develop stronger and more positive interpersonal relationships throughout their lives than do people low in individual trait positive affect (Lyubomirsky et al., 2005). Researchers have linked individual trait positive affect with both the quantity of friends or close companions that people have (Pinquart & Sörensen, 2000) and with the quality of interpersonal relationships that people report (Diener & Seligman, 2002; Pinquart & Sörensen, 2000). Theorists explain the observed relationship between trait positive affect and friendship in a number of ways, but two explanations are especially notable. The first explanation focuses on how an individual *perceives* and *treats* others in his/her social environment, while the second explanation focuses on how a given individual *is perceived* and *is treated by others* in his/her social environment. The key distinction between these two explanations is the locus of positive affect as an explanatory mechanisms for friendship relationships; in the first explanation, it is the perceiver's positive affect that matters and in the second it is the perceived's.

I refer to the first explanation, which suggests that people high in individual trait positive affect evaluate all forms of stimuli—people, events, and things—in a consistently positive way, as the “rose-colored glasses explanation.” Focusing specifically on how people perceive others, this line of theory and research suggests that people who feel positively are more engaged with their social environments and assess interactions with others more

favorably than do people in either neutral or negative moods (Lyubomirsky et al., 2005). Isen's program of laboratory research [see Isen & Baron (1991) for a review], for example, has shown that people induced to feel positively—by watching happy movies or receiving a small, unexpected gift—perceive and evaluate others more positively, even behaving towards others in more positive ways than people not so induced. Isen's clever experimental studies have shown that people are more friendly, sociable, and talkative with others following a very simple mood induction. Using a similar experimental research approach, Baron (1987) found that people induced to experience positive affect are more likely to identify with a stranger, feeling an interpersonal connection to someone they do not know, than are people not induced to experience positive affect. And, in a meta-analysis of studies correlating subjective well-being (a variant of positive affect) with an exhaustive set of personality measures, DeNeve & Cooper (1998) found significant, positive relationships between well being and affiliation, sociability, and extroversion. People who feel good are more outgoing and friendly and have a greater desire to form relationships with others. Taken as a whole, extensive research support across laboratory and field studies led Lyubomirsky et al. (2005, p. 836) to conclude from their qualitative review of the literature on positive affect, "When feeling happy, people tend to seek out social interactions."

The second explanation for the relationship between positive affect and friendship, which I refer to as the "halo explanation" underscores the evaluations, perceptions, and responses that those high in positive affect *elicit* from others. Whereas the perceiver is the locus of positive affect in the rose-colored glasses explanation, a significant body of evidence also suggests that positive affect shapes positive social interactions when the locus of positive affect is the perceived. Positive people, this line of research suggests, attract more positive behaviors, perceptions, and relationships from others than do their less positive peers. Veenhoven (1988) found that people who are predisposed to experience frequent positive moods are rated by others as engaging and socially attractive. The effect of

positivity on shaping the perceptions of others can be strikingly subtle. In their study of interpersonal perception, Kashdan & Roberts (2004) found that observers rated women's college yearbook photos more positively if they were expressing positive affect in their pictures through their facial expressions, leading Kashdan & Roberts (2004) to conclude that even the slightest indication that someone is positive leads others to rate him/her in a more favorable light. As reviewed by Lyubomirsky et al. (2005), researchers have studied a number of evaluative outcomes, including ratings of physical attractiveness, intelligence, friendliness, and morality. Across outcomes, those high in positive affect are viewed more favorably by others than those low in positive affect, leading Lyubomirsky et al. (2005, p. 827) to conclude that "most respondents like happy people much more than they like their less-than-happy peers."

Team trait positive affect, defined above as the stable tendency for team members to experience shared positive affective states, may shape team friendship network density through both the rose-colored glasses and halo mechanisms especially during the earliest days of team life. Because team members have limited direct information about one another in the early days of team life, the perceptual biases of positive affect are likely to mold how favorably team members view one another in terms of friendship. If team members relatively uniformly feel a certain way during team interactions, the individual-level research cited above suggests that team members may perceive and relate to one another in a relatively uniform way. In a team high in team trait positive affect, shared positive feelings activate in team members both the rose-colored glasses effect and the halo effect; team members wear the same rose-colored glasses when they perceive one another and all team members have halos hovering above their heads. In a team low in team trait positive affect, on the other hand, perceptions of others are likely less positive and individuals are less likely to elicit positive responses from others. Together, these effects of positive affect on both the perceiver and the perceived lead members of teams high in team trait posi-

tive affect to view one another in more positive ways and to see each other as more likely candidates for friendship than members of teams lower in team trait positive affect. The increased likelihood of friendship relations leads to a relatively denser intrateam friendship network early in the project timeframe in teams higher in team trait positive affect than teams lower in team trait positive affect.

Hypothesis 8: Team trait positive affect is positively related to initial team friendship network density during the early development phase of project team life.

Growth in friendship network density across team development

According to an episodic conceptualization of project team development, the initial friendship network built during early development is an input into subsequent phases of team development (i.e., the midpoint transition and, further, late development). Theory and research on positive affect in group settings suggest that team trait positive affect may contribute further to ongoing, continuous growth in friendship network density from early development, past the midpoint transition, and through late development for two reasons.

First, a strong and dense friendship network is a channel that transmits and communicates affective experiences throughout a team (Bartel & Saavedra, 2000; Hareli & Rafaeli, 2008; Lawler, 2001; Totterdell et al., 1998, 2004; Walter & Bruch, 2008); emotions flow among team members through their interpersonal connections. When the team friendship network is dense, emotions flow more easily among team members than when the network is sparse. Across two field studies of affect and organizational networks, Totterdell and his colleagues (2004, p. 864) found that “groups of employees who are most interconnected in the network of ties show most consistency in their affect.” Totterdell et al. (2004) interpreted their findings as evidence that moods and emotions flow through social networks like electricity flows through the wires of a power grid. To illustrate, consider the example of a

team member who, on her own, has some positive affective experience due to situations or events external to the team (e.g., she is overjoyed by winning a raffle). If on a team with a dense friendship network, she is more likely to interact with team members on a regular and informal basis, thus increasing the likelihood that she might quickly infect her teammates with her positive mood through mood contagion—a process whereby moods and emotions transfer from one person to another through implicit facial signals, vocal tones, and explicit communication processes (Allport, 1924; Barsade, 2002; Bartel & Saavedra, 2000; Ilies et al., 2007). On a team with a sparse friendship network, on the other hand, mood contagion is less likely to occur; the focal team member is both less likely to interact with others on the team while her positive mood is active and even if she does there is a greater chance that her mood will run into a dead end in the network. Much like a power grid with broken wires fails to deliver electricity, a sparse network is relatively ineffective in channeling moods and emotions throughout the team. Of course, while a dense network is equally effective and efficient in spreading negative moods, in teams high in team trait positive affect members are predisposed to experience positive moods and emotions (George, 1990). As such, the initial friendship network composed during early development—which I have posited is denser for teams high in team trait positive affect—likely carries positive moods and emotions on a fairly regular basis, transmitting them throughout the team. Positive moods are thus more likely to fill the dense and interconnected channels of a team high in team trait positive affect, rippling positivity throughout the network whenever one team member feels positively. This repeated transmission of positive affect throughout the network may then further activate the rose-colored glasses and halo effects described above and increase the probability that new friendship relations develop or existing friendship relations strengthen (Walter & Bruch, 2008).

A second reason that a team's friendship network density may change over time is that friendship relations are themselves potential sources of positive moods and emotions. The-

orists (e.g., Lawler, 2001; Kelly & Barsade, 2001; Newcomb, 1961; Walter & Bruch, 2008) suggest that social relationships among team members—both positive and negative—are sources of affect. Lawler (2001) proposed that positive relationships among team members, such as friendship, generate positive emotions and that these relationally-based emotions in the context of a group can contribute to feelings of cohesion and attachment. In a team high in team trait positive affect, which has developed a relatively denser friendship network, relationally-based emotions are likely to be more positive than in team low in team trait positive affect (Lawler, 2001). Such positive relationally-based emotions, Lawler (2001, p. 329) claimed, increase the “strength and durability of person-to-group and person-to-person relations,” further enhancing the interconnectedness of the project team over time.

Because positive social relationships both generate and communicate positive affective experiences, I propose that team trait positive affect may thus have a “Matthew effect” (Merton, 1968) on friendship network density, spurring and sustaining a virtuous cycle of growth in friendship over time (Hareli & Rafaeli, 2008; Walter & Bruch, 2008). I posit that team trait positive affect has a primal role in launching this cycle for two reasons. First, team trait positive affect is by definition a team’s *stable* or *dispositional* tendency to experience positive moods over time. Research has shown that dispositional affect in individuals is relatively stable across the lifespan (Staw et al., 1986; Staw & Ross, 1985). As I have hypothesized above, team trait positive affect, which is in part a function of team members’ individual trait positive affect, similarly is likely to remain stable across the course of a team’s lifespan. Second, while it is possible that team members bring existing relationships into the team—perhaps, for example, team members choose to join a team or are selected to participate in a project due to extant relationships—prior research (e.g., Keller, 2001) suggests that the members of short-term project teams typically do not have prior experience working with one another. Because team trait positive affect is

a stable disposition and project teams are typically comprised of unfamiliar members, I propose that it is team trait positive affect that kicks off the virtuous cycle of growth in friendship network density by regularly activating both the rose-colored glasses and halo effects. These effects aid in the development of initial friendship ties and, over time, these friendship ties both encourage and transmit future positive affective experiences among team members. Through this cycle, teams higher in team trait positive affect are likely to develop increasingly denser friendship networks over time and across phases of team development compared to teams lower in team trait positive affect.

Hypothesis 9: Team trait positive affect is positively related to growth in team friendship network density over the course of project team life.

Summarizing my predictions regarding the development of team friendship network density, I propose that team trait positive affect facilitates the initial development and continued growth of friendship network density over the course of project team life. By shaping interpersonal perception such that people experiencing positive moods view others (i.e., rose-colored glasses) and are viewed by others (i.e., halo) in positive ways, teams high in team trait positive affect, I suggest, develop relatively denser networks during early development than teams low in team trait positive affect. Over time, I posit, a dense friendship network combined with high team trait positive affect results in a virtuous cycle of growth in friendship network density, as friendship ties both generate and communicate positive moods, which then further shape interpersonal perceptions and relationships.

Team Trait Positive Affect and the Development of Team Efficacy over Time

Similar to friendship network density, the formation of team efficacy—shared perceptions among team members that the team can effectively complete its tasks (Gibson, 1999)—may

begin even before team members start to actively work together on their tasks. Individual team members, once they have initial knowledge about other members of the team, the team's leader, and the team's tasks, may form very preliminary preconceptions about how likely it is that the team will succeed in its work. Once team members begin interacting with one another, they gain direct information about each others' abilities and the team's ability to work together effectively. This information leads individual perceptions of team efficacy to converge rapidly (Gibson & Earley, 2007; Tasa et al., 2007) in the early development phase. Because of how positive affect shapes self and interpersonal perception, as I detail below, team trait positive affect may contribute to initial efficacy beliefs and growth in efficacy over the course of team development.

Initial team efficacy during early development

During the early development phase, team members form initial shared perceptions of what their team can accomplish and the level at which their team can perform. At this point in team life, because project team members have limited information regarding how well their team can perform its tasks, members may base initial evaluations of one another on one another's reputations or very small slices of team interactions. During this information-scarce time, team trait positive affect may positively influence the development of initial team efficacy beliefs for two reasons.

First, optimism is a defining component of trait positive affect (Watson et al., 1988). People high in positive affect tend to perceive future events and situations in a positive way and expect positive outcomes to result from their efforts (Watson, 2002). Thus, a team high in team trait positive affect is a team relatively homogeneously composed of people who, individually, are likely to believe that they can accomplish their individual tasks and reach their individual goals. A team low in team trait positive affect, on the other hand, is likely composed of members who have relatively low expectations of themselves, in-

dividually. Indeed, in experimental studies, researchers (e.g., Brown, 1984; Kavanagh & Bower, 1985) have found a significant, positive relationship between individual-level positive affect and self efficacy—an individual's belief that he or she can perform effectively at a task. And, in two recent longitudinal field studies of insurance sales agents, Tsai et al. (2007) documented a strong, positive relationship between the tendency to experience positive moods and self efficacy; when people feel good they expect, individually, that they can perform at a high level. Members of teams high in team trait positive affect are thus likely to develop *shared* perceptions of high team efficacy in part because each individual team member evaluates his/her own capabilities in a positive, optimistic manner. Although team efficacy is more than just a simple aggregation of team members' perceptions of self efficacy (Gibson & Earley, 2007), individual self efficacy does contribute to team efficacy, in part, in an additive way (Gibson, 2003). As such, one reason for a positive relationship between team trait positive affect and team efficacy is that the members of teams high in positive affect expect more of themselves as individuals than do the members of teams low in team trait positive affect.

The additive combination of individual team members' self perceptions explains, however, only a part of the team efficacy construct (Gibson & Earley, 2007). A second reason why team trait positive affect likely breeds team efficacy is that, as described in my predictions regarding team trait positive affect and friendship density, positive moods and emotions shape interpersonal perceptions. Relevant to team efficacy in particular, positive affective experiences influence both how people rate others and how people are rated by others (i.e., the rose-colored glasses and halo effects described above) in ability and performance (Lyubomirsky et al., 2005). With respect to the rose-colored glasses effect, people experiencing positive moods view others more favorably on a number of performance-relevant dimensions, such as self-assuredness, than do people not experiencing positive moods (Berry & Hansen, 1996). With respect to the halo effect, a number of studies (e.g.,

Staw, Sutton, & Pelled, 1994; Wright & Staw, 1999) have found that people higher in positive affect are rated by others as smarter, more competent, and higher performing than people lower in positive affect. Diener & Fujita (1995) collected extensive data from students, their friends, and their family members and found that students higher in positive affect were rated as more intelligent and more competent than students lower in positive affect. Thus, similar to how positive affect shapes people's perceptions of the viability of others as friends both from the vantage point of the perceiver and the perceived, positive affect colors perceptions of ability and performance.

If project team members have confidence in one another's abilities, they are more likely to share a sense of collective efficacy than if team members are uncertain or feel negatively about the likelihood that fellow team members can contribute meaningfully to team performance (Gibson & Earley, 2007). Consistent with this explanation, Gibson (2003) found in both experimental and survey-based research that team trait positive affect is significantly, positively related to team efficacy. Consistent positive affective experiences during the early development phase—a time when direct information about team abilities is scarce—thus likely lead members of teams high in team trait positive affect to feel more positively about their teams' abilities than members of teams low in team trait positive affect. In the absence of direct information about one another's capabilities, the perceptual effects of positive affect are likely to color and bias members' beliefs about the likelihood that their team will succeed. Accordingly, I hypothesize:

Hypothesis 10: Team trait positive affect is positively related to initial team efficacy during the early development phase of project team life.

Growth in team efficacy across team development

As team members work together on a regular basis, they gain direct information regarding one another's individual capabilities and their collective ability to work together as a well-

coordinated team. This information is likely to be especially prominent and salient during the midpoint transition phase of project team development, which is often characterized by an intense focus on task-based concerns (Gersick, 1988). In reflecting on, discussing, and debating the merits of various approaches the team has taken to its tasks to date, team members may renew or revise their efficacy beliefs. And, as team members share in-depth information with one another and openly debate the future direction that their team will take, members' shared confidence in their team's abilities to complete its tasks may be strengthened, weakened, or unchanged. While the mechanisms discussed above—self-perception and other-perception regarding abilities and performance—likely continue to operate through the midpoint transition and throughout late development, team trait positive affect may drive growth in team efficacy across team development for additional reasons.

Gibson's (2003) cognitive information-processing explanation for how team trait positive affect shapes efficacy beliefs in teams is particularly relevant to understanding how team efficacy changes over team development as team members accumulate direct evidence for one another's abilities and of their collective ability to work together effectively. In her conceptual model, Gibson (2003) drew from theory and research on mood congruent memory at the individual-level to explain how team-level positive affect enhances team efficacy. Mood-congruent memory describes the tendency for people to recall information more easily when they feel similar to how they felt when the information was learned or stored (Bower, 1981). For example, if one memorizes a list of terms when in a positive mood, one will be more effective and efficient in recalling those terms if in a positive mood while recalling them. Gibson (2003, p. 2175) argued that positive affect similarly supports and enhances efficacy in teams "because groups experiencing a positive affective state often limit their search in long-term memory to positive information about their capabilities, progress, and performance. Thus, with only positive information accessible, the group believes that it can perform well, and the group efficacy beliefs are stronger." In

two empirical studies—one in the laboratory and one in the field—Gibson (2003) found a positive relationship between team trait positive affect (as rated by external observers) and team efficacy (as rated by team members).

During the midpoint transition, when team members work to make sense of the direction that their team is heading (Gersick, 1988) and in the late development phase when the project deadline is approaching, mood congruent recall is particularly relevant. In teams high in team trait positive affect, which I have posited are more likely to exhibit shared positive moods throughout development, team members will collectively remember, discuss, and dwell on positive features and events in their team's history. They will thus disproportionately recall the positive over the negative and the salience of these positive events will drive an increase in team efficacy as members perceive their team as stronger, more capable, and more successful as time passes. In teams low in team trait positive affect, on the other hand, team members will collectively remember, discuss, and dwell on relatively less positive experiences and events in their team history, disproportionately discussing times when they were perhaps less successful. These recollections do little to strengthen team members' perceptions that they can collectively complete their tasks effectively. Accordingly, I hypothesize:

Hypothesis 11: Team trait positive affect is positively related to growth in team efficacy over the course of project team life.

Summarizing my predictions regarding the relationship between team trait positive affect and the developmental trajectory of team efficacy over time, I propose that team trait positive affect is positively associated with initial team efficacy and drives increasingly positive team efficacy over time. Because positive affect colors individuals' perceptions of their own and others' abilities, even in information-scarce times, the members of teams predisposed to experience positive collective moods on a regular basis will share a com-

mon belief that they can accomplish their tasks. Over time, through the effects of positive affect on cognition, teams differentially store and recall information about their successes and failures, with frequent experiences of positive affect leading to recollections of team successes more than recollections of team failures or struggles. In recalling and reflecting on times when they have been successful, teams high in team trait positive affect grow in team efficacy over time, while teams low in team trait positive affect do not.

Team Trait Positive Affect, Developmental Trajectories, and Project Team Effectiveness

The final set of links and predictions in my theory of positive affect and team development and effectiveness describes the relationship between how teams develop resources over time and effectiveness in completing project tasks. In contrast to early descriptive accounts of team development (e.g., Tuckman, 1965), which painted a picture of teams following a standard or typical developmental path over time, project teams theorists (e.g., Ericksen & Dyer, 2004; Kozlowski et al., 1999) have more recently worked to document how teams differ in the paths that they travel over time and, especially, how the paths that a team travels in developing resources might impact team effectiveness. Some developmental trajectories, theorists suggest, are optimal for maximizing team effectiveness at the project deadline, while other trajectories leave a team ill-equipped to perform effectively as the project deadline arrives and team life comes to a close. Although theorists (e.g., Kozlowski et al., 1999; Marks et al., 2001) have frequently asserted that the pattern or trajectory of team development matters for team performance, few empirical studies have actually tested this assertion. And, empirical tests that have been conducted are, with notable exceptions (e.g., Jehn & Mannix, 2001), qualitative studies of a handful of project teams (e.g., Ericksen & Dyer, 2004).

As I describe in detail below, and in line with extant theory on team development and effectiveness (e.g., Ericksen & Dyer, 2004; Kozlowski et al., 1999), I hypothesize that team developmental trajectories with respect to team task routines, team friendship network density, and team efficacy—that is, the paths that a team takes in developing these three resources over time—are related to effectiveness in completing the team project. Furthermore, through its impact on each of these team resources, I propose that team trait positive affect—a team’s stable tendency to experience shared positive moods—indirectly impacts team effectiveness.

The Trajectory of Team Task Routine Development and Project Team Effectiveness

Project team theorists (e.g., Gersick, 1988; Kozlowski et al., 1999) often describe an ideal pattern of task routine development in which teams engage in healthy experimentation and exploration during the early phases of team development, but shift their focus after the midpoint transition to making incremental refinements to selected approaches. Developing team task routines, as described above, is a process of variation, selection, and retention. Scholars (e.g., Ericksen & Dyer, 2004; Gersick & Hackman, 1990; Kozlowski et al., 1999) have offered that team effectiveness is maximized when these activities—variation, selection, and retention—occur in sequence across the phases of project team development, with a variation focus during early development, selection activities dominating the midpoint transition, and retention the dominant goal of late development. Each piece of this process is essential for routine development; a team cannot retain routines until it selects them and cannot select routines until it generates or discovers them (Gersick & Hackman, 1990; Gibson & Vermeulen, 2003). Project teams that fail to engage in exploratory search early in development will have limited ideas and routines in their option pool to select and develop

through exploitative refinement during later phases of development. And, project teams that fail to close down exploratory search after the temporal midpoint leave themselves insufficient time to practice, store, and retain interdependent task routines in collective team memory; such teams are stuck with raw, unrefined ideas (Cohen & Bacdayan, 1994; March, 1991).

The ideal pattern of team task routine development, then, is one in which teams engage in high levels of exploratory search from early development through the midpoint transition, but close down exploration following the temporal midpoint. In project teams navigating the midpoint transition, maximizing behavior could be particularly harmful. Seeking the “best” possible solution, regardless of costs, could interfere with a project team’s ability to meet the tight, fixed deadline for its deliverables. As the team deadline approaches during late development, team effectiveness is maximized by very slight modifications to team approaches and a focus on exploitative refinement (Gersick, 1988; Kozlowski et al., 1999). Accordingly, I hypothesize the following:

Hypothesis 12: Initial exploratory search during the early development phase of project team life is positively related to project team effectiveness.

Hypothesis 13: Growth in exploratory search over project team life is negatively related to project team effectiveness.

Hypothesis 14: Growth in exploitative refinement over project team life is positively related to project team effectiveness.

And, following from my hypotheses regarding the relationship between team trait positive affect and the trajectories of exploratory search and exploitative refinement, respectively, I hypothesize:

Hypothesis 15: Team trait positive affect is indirectly positively related to team effectiveness through (a) initial exploratory search; (b) growth in exploratory

search over project team life; and, (c) growth in exploitative refinement over project team life.

The Trajectory of Team Friendship Network Density Development and Project Team Effectiveness

Scholars argue that positive intrateam social networks facilitate high team performance by increasing intrateam communication, cooperation, and commitment to team activities (Beal et al., 2003; Lawler, 2001; Jehn & Shah, 1997; Weick, 1969). There is strong empirical support for these predictions. In a laboratory experiment, Jehn & Shah (1997) found that groups of friends performed significantly better than groups of acquaintances on laboratory tasks due to enhanced group processes, such as communication and cooperation. And, although there have been conflicting theoretical predictions offered regarding the specific role of friendship network density, Balkundi & Harrison (2006) recently provided meta-analytic evidence for a positive relationship between friendship network density and team performance. Based on the combined findings from 37 studies, Balkundi & Harrison (2006) reported that the true score correlation between friendship network density and team performance is positive and moderate in strength ($\rho = .22$).

Team cohesion, though not the same construct, is a very similar construct to team friendship network density. The interpersonal attraction component of the team cohesion construct space is especially similar to friendship network density (Beal et al., 2003). Research on this component, which describes how attached members of a team feel to one another (Beal et al., 2003), similarly suggests that teams with dense friendship networks outperform teams with sparse friendship networks. Much like the findings regarding friendship network density and performance, there is meta-analytic support (i.e., Beal et al., 2003) for a moderate, positive relationship between the interpersonal attraction component of team

cohesion and team performance ($\rho = .20$). And, interestingly, Beal et al. (2003) found that the interpersonal attraction component of cohesion showed a particularly strong relationship with measures of team performance that emphasized efficiency ($\rho = .34$), something likely to be especially valuable in project teams that often have short timeframes and limited budgets with which to complete their tasks (Ericksen & Dyer, 2004).

Both components of a team's developmental trajectory with respect to team friendship network density—initial friendship density and growth in friendship density over time—likely impact project team performance. Above, I proposed that team trait positive affect initiates a virtuous cycle of friendship network development, in which frequent experiences of positive moods and emotions make friendship links more likely to develop during early team life and these initial friendship links breed additional positive affect and further positive interpersonal relationships. A team that develops an initially well-connected friendship network is thus more likely than a team with a sparse initial friendship network to fall into this cycle. If friendship network growth is path dependent, or partially a function of the starting point, then a team that starts the cycle with a dense network will be able to reach higher overall levels through growth over time than will a team that starts with a relatively unconnected network.

Hypothesis 16: Initial team friendship network density during the early development phase of project team life is positively related to project team effectiveness.

Although this starting point of initial friendship network density is important, because project teams are typically composed of people who are not familiar with one another when the team forms (Ericksen & Dyer, 2004), growth from this initial starting point is also likely to positively impact team effectiveness. Holding constant the initial friendship network, teams in which members are able to deepen their relationships with one another

and form additional relationships in the team are likely to exhibit increased cooperation and helping behavior over time (Beal et al., 2003; Jehn & Shah, 1997). And, furthermore, teams that deepen their relationships over time are better-equipped to execute interdependent task routines requiring coordination among team members (Harrison, Price, Gavin, & Florey, 2002).

Hypothesis 17: Growth in team friendship network density over the course of project team life is positively related to project team effectiveness.

Following from my earlier predictions regarding the relationship between team trait positive affect and the development of friendship network density over time, I also thus hypothesize that team trait positive affect is indirectly, positively related to team effectiveness through its effects on the development of friendship network density over time.

Hypothesis 18: Team trait positive affect is indirectly positively related to project team effectiveness through (a) initial team friendship network density and (b) growth in team friendship network density over project team life.

The Trajectory of Team Efficacy Development and Project Team Effectiveness

Theorists (e.g., Bandura, 1997; Gibson, 1999; Gibson & Earley, 2007) suggest that team efficacy drives teams to perform at high levels by leading them to set high goals, exert significant effort in pursuing those goals, and persist in their efforts to overcome adversity that might arise in the midst of goal-directed activity. A significant body of empirical research supports these claims. Gully et al. (2002) conducted a meta-analysis of research on team efficacy and team performance and found that team efficacy is positively and moderately related to team performance ($\rho = .41$). When members of teams share a perception that they can collectively perform at a high level, they do.

As described above, I propose that the development of team efficacy in teams is a self-reinforcing cycle, similar to the development of friendship network density over time. If initial levels of team efficacy are high, project teams are likely to set high goals and to persist in working to attain those goals (Lindsley et al., 1995). The attainment of high goals, in turn, yields positive affective experiences and subsequent effective goal-setting and effort. Over time, steadily increasing team efficacy signals a progression towards distal team goals and steady improvement in team capabilities as goals are set increasingly higher. If initial levels of team efficacy are low, however, project teams are likely to set low goals and exert relatively little effort to achieve these goals (Gibson, 1999). If, as is probable, such teams are unable to attain even these low goals, team members are likely to continue to downwardly revise their perceptions of their abilities, setting lower goals. This downward trajectory likely inhibits the development of critical team capabilities (Bandura, 1997). Initial levels of efficacy, therefore, are critically important for both the development of efficacy over time and for team effectiveness. Said differently, similar to the role that initial team friendship network density plays in the growth of density over time, growth in team efficacy is path dependent; initial levels of efficacy are the starting point from which efficacy grows.

Hypothesis 19: Initial team efficacy during the early development phase of project team life is positively related to project team effectiveness.

Hypothesis 20: Growth in team efficacy over the course of project team life is positively related to project team effectiveness.

And, again, following from my predictions regarding the influence of team trait positive affect on the development of team efficacy over time, I hypothesize:

Hypothesis 21: Team trait positive affect is indirectly positively related to

project team effectiveness through (a) initial team efficacy and (b) growth in team efficacy over the course of project team life.

Figure 1 on page 6 summarizes my conceptual model regarding team trait positive affect, the development of team task routines, team friendship network density, and team efficacy over time, as well as the impact of these developmental trajectories on team effectiveness. To examine my hypotheses and evaluate the overall validity of my theoretical model, I conducted an in-depth longitudinal study of project teams preparing for and participating in a military competition.

Method

Research Setting

Top administrators of the United States Military Academy at West Point granted me access to study teams preparing for and participating in the Sandhurst Competition—an international, team-based military competition held annually at West Point. The Sandhurst Competition has a long history at West Point with rich tradition. This history began in 1967 when the leaders of Great Britain’s Royal Military Academy Sandhurst (RMAS) sent a British officer’s sword to the leaders of West Point and directed that the sword should serve as a prize awarded to the champion of a team-based competition. The instructions delivered with the sword outlined that the competition should “provide the Corps of Cadets with a challenging and rewarding regimental skills competition, which will enhance professional development and military excellence in selected soldier skills” (United States Military Academy, 2006, p. 1). In the early years of the competition only teams from West Point—one team representing each cadet company—participated in the event.² Over time, however, West Point officials modified aspects of the competition and invited teams from other military academies, including Great Britain’s RMAS, the Royal Military College of Canada (RMC), and teams from United States Reserve Officer Training Corps (ROTC) programs. Today, West Point leaders use the competition “to test cadets’ ability to ‘move,

²A cadet company is a division of the student body or “Corps of Cadets.” A company is composed of roughly 120 cadets.

shoot, and communicate,’ stressing teamwork among the classes as a fundamental and essential aspect of the competition” (United States Military Academy, 2006, p. 1).

The Sandhurst Competition is a one-day event in which nine-person teams, including a formal team leader, must navigate a nine-kilometer obstacle course packed with ten challenges, such as diagnosing and repairing faulty communications equipment, crossing a river gap, climbing a ten-foot wall, and providing medical triage to battlefield casualties. A team receives a unique score for its performance on each of the ten challenges that accounts for how fast the team completed the challenge and its adherence to formal competition guidelines throughout the challenge. In addition to the individual challenge scores, teams receive an overall score for how quickly they navigate the full nine-kilometer course to complete the competition. The winner of the Sandhurst Competition is the team that receives the highest sum total score across these separately-scored and differentially-weighted components.

Although the actual competition is a one-day event, teams formally train for the competition over the course of approximately four months. Formal team leaders have discretion over the method, frequency, and intensity with which they schedule and hold team training sessions, but competition guidelines govern the broad temporal parameters of the training program. Specifically, teams are prohibited from beginning formal training (and, indeed, do not have access to necessary training sites and equipment) prior to an official start date and the publication of “Operational Orders.” Furthermore, teams’ access to certain required resources (e.g., the range, rifles, and ammunition for marksmanship practice) is regulated throughout the four-month training period.

Sandhurst Competition teams are composed of cadets who volunteer to represent their military academies and preparatory programs. Most academies send only one or two teams. As the hosting academy, however, West Point enters one team to represent each of the 32 cadet companies and one “Brigade” team, which represents all of West Point. The Brigade

team is, by design, an all-star team of West Point cadets assembled to challenge the teams representing Great Britain and Canada, who are perennial favorites to win the event. In total, therefore, West Point enters 33 teams in the competition. These 33 teams compete not only for the overall Sandhurst championship, but also for intra-institutional awards and recognition.

Formal competition guidelines regulate the makeup of Sandhurst Competition teams. Specifically, to participate in the competition, a team must be composed of no more than nine members, including the formal team leader. The team leader is a cadet who volunteers to fill the role and who has been selected by non-cadet West Point officials. Of the nine Sandhurst team members, there must be one cadet from each West Point class—one Plebe (freshman), one Yearling or Yuk (sophomore), one Cow (junior), and one Firstie (senior). There also must be at least one female cadet on the team. Although the competition is limited to only nine team members, teams typically train with more than nine cadets during the four-month training period. Training additional team members is necessary because physical injuries during training are an unfortunate but all-too-frequent reality. Having more than one female member and more than one member from each class is thus critical; an injury to a team's lone female or Plebe would prevent the team from competing on game day.

For a variety of reasons the Sandhurst competition is an attractive setting in which to study the effects of team trait positive affect on project team development and effectiveness. Sandhurst teams are project teams—they are relatively short-lived groups of people brought together to work interdependently and accomplish a specific task in a specific time period before disbanding (Ericksen & Dyer, 2004). Because organizations are increasingly adopting such project team-based structures to accomplish a broad range of organizational tasks ranging from research and development to product troubleshooting (Keller, 2001), the findings of a study of Sandhurst teams can have real and meaningful implications for

contemporary organizational settings. Clearly most organizational settings, particularly for-profit settings, are not as structured or regulated as the Sandhurst Competition. The structure of the setting, however, while requiring that generalizations to traditional organizational settings must be made with care, creates a number of benefits for the internal validity of the research. First, because of the official rules that govern team training, the Sandhurst Competition provides an opportunity to study in parallel multiple teams from the beginning of team formation through task completion. Second, the tasks that Sandhurst teams are charged with completing are constant across teams; in most for-profit settings, it is rare to find a sizable number of teams working independently on the same set of tasks. And, third, the Sandhurst Competition provides a clean, objective measure of team performance that is equivalent across teams.

Sample and Procedure

I collected longitudinal survey data from the members of the 33 teams representing West Point in the Sandhurst Competition. Thirty-two of these teams were company-based; that is, each of these teams represented one of the 32 companies that make up the West Point Corps of Cadets. As described above, the remaining team—the Brigade Team—was composed of cadets selected from the entire Corps of Cadets to represent West Point effectively in competing against teams from other military academies.

With the help of Sandhurst Competition administrators and formal team leaders, I identified formal Sandhurst team members (i.e., cadets on a formal team roster) and informal team members (i.e., cadets training informally as alternates) prior to the start of the formal training period. Counting the team leader and informal team members, who sometimes became formal team members in the event of an injury to a formal member during the training period, teams ranged in size from 10 to 17 members ($\bar{X} = 11.5$, $SD = 1.33$). The sample

was predominantly male (86%) and White (79%). Participants ranged in age from 17 to 24 years ($\bar{X} = 20.3$, $SD = 1.40$), with 22% Plebes (freshmen), 21% Yearlings (sophomores), 27% Cows (juniors), and 29% Firsties (seniors).

Prior to the start of the study, Sandhurst Competition administrators notified participants of the broad purpose of the research and that the senior leadership of West Point, as well as institutional review boards at West Point and the University of Pennsylvania, had approved the research project. Over the course of the study, which ran for approximately four months, participants completed four internet-based surveys. The first survey (Time 0), collected in the week prior to the start of the formal training period, focused on participants' background, personality, and preliminary information about the team. Individuals' trait affect and various control variables were assessed in this Time 0 survey. The second through fourth surveys (Time 1, Time 2, and Time 3) focused on team activities, team emergent states, and relationships among team members. Participants completed the Time 1 survey approximately two weeks into the formal training period, the Time 2 survey at approximately the temporal midpoint of the formal training period, and the Time 3 survey one week prior to the Sandhurst Competition. Thus, the survey periods were timed to coincide with the critical episodes of project team development: team formation (Time 0), early development (Time 1), the midpoint transition (Time 2), and late development (Time 3). Finally, I refer to the formal Sandhurst Competition, which occurred one week after the final survey and represents my measure of team effectiveness, as Time 4.

At each survey period, I emailed each targeted respondent a personally-addressed message that included a hyperlink to his/her survey. For each period, the survey window remained open for seven calendar days. Staggered across this 7-day window, I sent three personally-addressed email reminders to any non-respondents. In each survey, I asked team leaders to indicate any changes in the formal or informal composition of their teams. Thus, while infrequent, some team members dropped out of their teams and some new cadets

joined competition teams. This, combined with some cadets indicating at different points in the study that they no longer wished to participate in the research, led to fluctuation in the number of participants across time.

At Time 0 I sent 359 cadets a survey link. Of these, I received 330 valid responses, 5 cadets indicated that they would not be participating in the competition, and 3 cadets declined to participate in the study (94% response rate). At Time 1 I sent 365 cadets a survey link. Of these, I received 303 valid responses, 15 cadets indicated that they were no longer team members, and three cadets declined to participate further in the study (87% response rate). At Time 2 I sent 361 cadets a survey link. Of these, I received 292 valid responses, 4 cadets indicated that they were no longer team members, and 2 cadets declined to participate further in the study (82% response rate). At Time 3 I sent 357 cadets a survey link. Of these, I received 262 valid responses, one cadet indicated that he/she was no longer a team member, and one cadet declined to participate in the final survey (74% response rate). Average team-level response rates were 91%, 85%, 82%, and 74% at Times 0, 1, 2, and 3, respectively. Across all teams and times (i.e., 132 team-by-time observations), two team-level response rates fell below 50% (two teams' Time 4 response rates were 30%).

Measures

I describe below the measures used in this study. For survey measures, I provide interitem reliability at the conceptual level of analysis for the construct, following Chen, Mathieu, and Bliese's (2004) recommendations that researchers should investigate the psychometric properties of their measures at the level(s) of analysis at which the constructs operate. I thus provide Cronbach's alpha at the individual-level for individual-level constructs and at the team-level for team-level constructs.

Team ability (control)

As a control in analyses involving relationships with team effectiveness, I measured a composite variable representing team ability across three task-relevant dimensions: academic ability, athletic ability, and military ability. At West Point, cadets receive grades and a separate class rank for each of these dimensions. Wishing to control for team ability simply due to the additive combination of individual team member abilities (i.e., ability as a function of team composition), I asked team members at Time 0 to provide their percentile class rank for each dimension separately. To operationalize the composite team ability variable, I computed the team mean across members' percentile rankings on each of these dimensions, then computed the mean across the dimensions. The team-level alpha for the aggregated ability score was relatively low at 0.58.³

Team experience (control)

Because Sandhurst is an annual competition, some team members may have participated in prior years' competitions or may have trained as alternates in a prior year. Teams composed of members with more experience might outperform teams composed of members with less experience in the competition. So, I controlled in analyses involving relationships with team effectiveness for team experience, which I conceptualized as an additive variable and operationalized as the team mean of the number of prior competitions in which team members had participated. I asked team members at Time 0 to indicate the number of prior competitions for which they had trained.

³Because of the low interitem reliability of this composite score, I also tested in supplementary analyses not reported the relationship between individual ability measures and team effectiveness. Regardless of whether separate measures or the composite was used, the relationship between ability and team effectiveness was weak, nonsignificant, and other coefficients remained stable. For parsimony, I report the results of the single variable composite rather than multiple variables representing team ability.

Team formation activity (control)

I also control in analyses involving team effectiveness for team formation activity—how active a team is during the initial stages of team formation, but prior to the formal launch of the project team. Recent qualitative research indicates that early team activity is related to project team effectiveness (Ericksen & Dyer, 2004). I measured team formation activity at Time 0 by asking team leaders to indicate how many meetings their team had during the formation stage and before formal project launch.

Individual trait positive affect

I measured individual trait positive affect at Time 0 using the 10 positive affect items from the PANAS scale developed by Watson et al. (1988). The trait version of the PANAS instructs participants to respond to a number of discrete emotions, indicating the extent to which they feel each emotion “in general.” Participants used a 5-point Likert-type response scale ranging from 1 = *Very Slightly or Not at All* to 5 = *Extremely*. Sample items are “Interested” and “Enthusiastic.” Alpha for the trait positive affect score was 0.89.

Team trait positive affect

Consistent with (George, 1990) and others (e.g., Gibson, 2003), I operationalized team trait positive affect by computing the team mean of members’ individual trait positive affect, which was measured, as described above, at Time 0 using the PANAS. At the team-level, alpha for the team trait positive affect score was 0.94.

Team positive mood

I measured team positive mood at Times 1, 2, and 3 using ten items adapted from (Barsade, 2002). Participants used a 5-point Likert-type scale ranging from 1 = *Not at All* to 5 =

A Great Amount to rate the extent to which each of the items characterized their team's interactions during the past week. Sample items are "Pleasant" and "Optimistic." Alpha values for the team positive mood scores at the team level were 0.88, 0.84, and 0.90 at Times 1, 2, and 3, respectively.

Exploratory search

I measured exploratory search at Times 1, 2, and 3 using six items adapted from Edmondson (1999). Participants responded to items on a 5-point Likert-type scale ranging from 1 = *Strongly Disagree* to 5 = *Strong Agree*, rating the extent to which each of the items characterized their team's interactions during the past week. Sample items are "This week we focused on discovering new ways of completing the Sandhurst obstacles" and "This week team members spoke up to test assumptions about how we complete our tasks." Team-level alpha values for the exploratory search scores were 0.92, 0.91, and 0.94 at, respectively, Times 1, 2, and 3.

Exploitative refining

I measured exploitative refining at Times 1, 2, and 3 using four items that I developed. Participants responded to items on a 5-point Likert-type scale ranging from 1 = *Strongly Disagree* to 5 = *Strong Agree*, rating the extent to which each of the items characterized their team's interactions during the past week. Sample items are "This week, we really focused on practicing and refining our methods for completing the Sandhurst obstacles" and "During this week, we were especially concerned with practicing the techniques we already know for completing our tasks." Team-level alpha values for the exploitative refining scores were 0.90, 0.92, and 0.86 at, respectively, Times 1, 2, and 3.

Directed dyadic friendship relations

I assessed directed dyadic friendship relations among team members—that is, each team members' perception of his/her friendship relationship with each other team member—with a single item at Times 1, 2, and 3. Participants used a 5-point Likert-type scale ranging from 1 = *Not at All* to 5 = *A Great Amount* to rate their relationship with their teammates in a round-robin fashion. Specifically, team members rated their friendship using a behavioral item: “How much did you socialize with [MEMBER] in your free time during the past week?” Participants were given a full roster of their team to rate their relationships with each other member.

Team friendship network density

When network ties are assessed in binary terms (i.e., one rates whether one is or is not a friend of another's), network density refers to the proportion of ties that are present out of the total number of possible ties. When dyad-level ties are assessed along a continuum, however, network density “is usually indicated by the average strength of the tie across all the relations” (Hanneman & Riddle, 2005). Because I measured directed dyadic friendship using a 5-point scale, I operationalized friendship network density, at Times 1 through 3, by computing the within-team mean friendship strength across directed dyadic friendship ties.

Team efficacy

I measured team efficacy at Times 1, 2, and 3 using a single item, which asked team members to provide their confidence in their team's ability to perform well in the Sandhurst Competition. Specifically, I asked each team member, “If you had to make a reasonable prediction today, where do you think your team will place in the Sandhurst Competition?”

Participants responded on a 5-point scale in which 1 = *Lower than 20th place*, 2 = *16 to 20th place*, 3 = *11 to 15th place*, 4 = *6 to 10th place*, and 5 = *1st to 5th place*. Such a measure is consistent with a view of team efficacy as a task-specific belief, rather than a more general belief in team abilities across tasks, which is more commonly referred to as potency (Gully et al., 2002).

Team effectiveness

I used the final certified results of the Sandhurst competition, collected at Time 4, to measure team performance. Teams receive a point total for each obstacle in the Sandhurst competition and a score for how quickly they make it through the competition course. Obstacles are weighted differentially in their contributions to the final overall competition score and, thus, placing in the competition. For example, a team can earn a maximum of 30 points for correctly and accurately using grenades to destroy a target (i.e., *Grenade Score*), a maximum of 75 points for an equipment inspection at the start (i.e., *Start Inspection Score*), and a maximum of 90 points for collectively scaling a 10-foot wall (i.e., *Ranger Wall Score*). A team's final score in the competition is the sum across the obstacle scores and the overall speed score. Teams are rank-ordered by the number of points that they receive to determine the winner of the competition. I operationally defined team effectiveness as the total number of points earned in the competition.

Analyses

Aggregation of Composition Constructs from Individual-Level Measures to the Team-Level

A number of constructs in my conceptual model are shared or consensus composition constructs—phenomena that the members of a team hold in common (Chan, 1998; Kozlowski & Klein, 2000). To assess whether the central tendency (i.e., the mean) of team members' perceptions is a valid measurement of these team-level variables, I computed James, Demaree, and Wolf's (1993) $r_{wg(j)}$ index—a measure of intragroup agreement or homogeneity—and two forms of the intraclass correlation: ICC(1) and ICC(2). ICC(1), which represents the percent of total variance in a construct accounted for by team membership, is computed from a one-way ANOVA in which the construct of interest is modeled as the criterion and team membership is the factor. ICC(2), which represents the reliability of group means, is computed from ICC(1) via the Spearman-Brown formula (Bliese, 2000). Together, this package of three indices gives insight into how much the members of a team agree with one another and how different teams are from one another, both of which are important for understanding the impact of combining individual team member perceptions into team-level metrics.

Table 1 presents $r_{wg(j)}$, ICC(1), and ICC(2) values for each consensus construct at each

Table 1: Aggregation Metrics for Team-Level Consensus Composition Constructs^{ab}

	ICC(1)	ICC(2)	$\bar{X}r_{wg(j)}$	SD $r_{wg(j)}$
Team trait positive affect (T0)	0.08	0.46	0.94	0.03
Team positive mood (T1)	0.09	0.47	0.96	0.02
Team positive mood (T2)	0.08	0.43	0.95	0.03
Team positive mood (T3)	0.08	0.41	0.95	0.03
Exploratory Search (T1)	0.19	0.68	0.83	0.10
Exploratory Search (T2)	0.12	0.54	0.77	0.21
Exploratory Search (T3)	0.16	0.60	0.72	0.22
Exploitative Refining (T1)	0.21	0.71	0.85	0.16
Exploitative Refining (T2)	0.12	0.54	0.84	0.20
Exploitative Refining (T3)	0.07	0.37	0.85	0.17
Team efficacy (T1)	0.39	0.85	0.63	0.24
Team efficacy (T2)	0.38	0.84	0.67	0.24
Team efficacy (T3)	0.40	0.83	0.72	0.21

^a Team-level N = 33; individual-level N = 330, 303, 292, and 262 at Times 0, 1, 2, and 3, respectively.

^b * $p < .05$, ** $p < .01$ two-tailed.

measurement point. As revealed by the ICC(1) values, in particular, there was significant between-team variance for each construct at each point in time. Across constructs, team membership accounted for between 8% (for Team Trait Positive Affect, Team Positive Mood at Time 2 and Team Positive Mood at Time 3) and 40% (for Team Efficacy at Time 3) of the variance in individual team member perceptions. The reliability of group means, assessed by ICC(2), was generally acceptable across constructs and across time, ranging from a low of .37 (for Exploitative Refining at Time 3) to .85 (for Team Efficacy at Time 1). Finally, across constructs and time there was high within-team agreement, as assessed by $r_{wg(j)}$. Unlike ICC(1) and ICC(2), which provide single, global estimates for the sample as a whole, $r_{wg(j)}$ is computed on a team-by-team basis. For team trait positive affect, 100% of team $r_{wg(j)}$ values were greater than the commonly-adopted standard of .70. Similarly, for team positive mood 100% of $r_{wg(j)}$ values were greater than .70. In the case of exploratory search, 78% of $r_{wg(j)}$ values exceeded .70 across teams and time. For

exploitative refining, 93% of $r_{wg(j)}$ values exceeded .70 across teams and time. Finally, for the single-item measure of team efficacy, team members showed relatively less agreement with one another, though there was substantial and significant between-team variance; 54% of r_{wg} values for team efficacy across teams and time were greater than .70.

Together, the results presented in Table 1 provide support for operationalizing these consensus constructs at the team-level using an aggregation of individual team member perceptions. While the intragroup agreement for team efficacy, across measurement instances, was low, there was significant between-team variance at each point in time, indicating that there were systematic team-based grouping effects for team efficacy. Additionally, the ICC(2) values for team efficacy over time indicate that the group means were sufficiently reliable to provide a stable indicator of team efficacy. Finally, the consequence of low intragroup agreement for team efficacy is increased measurement error, which biases test of relationships towards not finding, rather than finding, an effect; thus, statistical tests using team efficacy are more conservative (Schwab, 1980). I thus proceeded to represent team efficacy using the mean of team member responses due to the significant non-independence of team member ratings of team efficacy (Kenny & La Voie, 1985), the high reliability of the group means, and resulting bias away from finding an effect.

Analytical Approach for Evaluating Hypotheses about Change over Time

To evaluate hypotheses about patterns of change over time, organizational researchers generally use a family of techniques referred to as “growth modeling” (Singer & Willett, 2003). Growth modeling allows researchers to estimate both the typical pattern of change in a construct across a sample of individuals or teams and how individuals or teams may vary in their patterns of change over time. In growth modeling techniques, change is represented

by the combination of two key components: the change intercept and the change slope. The *change intercept* represents the starting point or initial status of the change trajectory. Most frequently, though not always, researchers use the change intercept to estimate where a team is at the start of the observation period (i.e., at the time of the first measurement). The *change slope* represents the amount of incremental change that occurs in a single unit of time (e.g., a day, a week, a month, a developmental phase). Researchers use the change slope to estimate the rate at which teams increase or decrease in a given construct across time. Depending on the number of repeated measurements, the change slope can be further broken down into linear and nonlinear components representing various forms of change (e.g., linear, quadratic, cubic).

While estimating the average or typical pattern of change in a construct is often of interest, growth modeling becomes a particularly potent analytical tool when a researcher poses hypotheses about how or why individuals or teams vary in their change patterns. With its flexible analytical framework, growth modeling enabling researchers to test predictions about differences across individuals or teams in the change intercept and in the change slope. Because I posit in my theoretical model that positive affect relates to patterns of change over time in the development of task routines, friendship network density, and team efficacy, growth modeling was particularly appropriate for evaluating my theory.

Common Growth Modeling Techniques in Team Development Research

Organizational researchers generally use one of two techniques in the growth modeling family. The first, *random coefficients modeling* (RCM) is used widely in the organizational literature for general multilevel analysis (i.e., beyond analysis of change over time). In the RCM growth model, which appears especially frequently in team development research (e.g., Chen, 2005; Mathieu & Schulze, 2006; Mathieu & Rapp, 2009), repeated measures of a construct (e.g., team friendship network density) are treated as hierarchically nested

observations within subjects or teams. The intercept of the regression equation, which can freely vary across teams, represents the change intercept (i.e., the starting point of the change trajectory). The effect of time, which can also freely vary across teams, represents the change slope (i.e., the incremental change from the starting point for a unit of time). Because both of these parameters—the intercept and the effect of time—are free to vary across teams, researchers can regress them on team-level covariates to determine whether stable (or variable) team-level attributes are related to (a) where a team starts (i.e., the change intercept) and (b) how much a team changes over time (i.e., the change slope). For example, consider my predictions regarding team friendship network density. I hypothesized that team trait positive affect is positively related to friendship density during early team development (i.e., the change intercept) and to growth in density over the course of the project timeframe (i.e., the change slope). To test these hypotheses, I could model team friendship network density over time using RCM and regress the varying intercept and varying slope, respectively, on team trait positive affect.

The second growth modeling approach commonly used in the organizational literature for examining hypotheses about change over time is *latent growth modeling* (LGM). Whereas RCM fits in a general regression-based framework, LGM fits in a general multivariate structural equation modeling framework. In LGM, repeated measures of a construct (e.g., team friendship network density) are viewed as indicators of latent factors that, respectively, represent the change intercept and the change slope. By fixing the loadings of the indicators on the intercept factor to one and fixing the loadings of the indicators on the slope factor to incremental units (e.g., Time 0 = 0, Time 1 = 1, Time 2 = 2, etc.), a researcher can estimate the average change intercept, the average change slope, as well as the variance of each of these factors. Using these estimated factor variances, a researcher can model relationships between the change intercept, the change slope, and other observed or latent variables conceptualized as covariates of the starting point and/or the rate of change.

Both the RCM approach and the LGM approach rely on maximum likelihood estimation (MLE) and, thus, in most cases RCM and LGM yield highly similar results and substantive conclusions [see (Willett & Sayer, 1994) for a detailed comparison of RCM and LGM methods]. Through MLE, parameter estimates are chosen that make the observed data most likely to occur. MLE, which is an asymptotically-optimal statistical method, generates solutions that are unbiased, efficient, and normal as sample size approaches infinity. Practically, this means that MLE generates the optimal solution for a growth model when sample size is large.

While RCM using MLE has been team development researchers' preferred statistical tool for evaluating hypotheses about change over time, recent simulation-based methodological comparison studies (e.g., Lee & Song, 2004; Zhang, Hamagami, Lijuan Wang, Nesselroade, & Grimm, 2007) suggest that MLE may yield suboptimal solutions for growth models under small sample conditions and/or when sample data are not normally distributed. More specifically, as (a) team sample size decreases, (b) the number of repeated measures decreases, and (c) data deviate from normality, MLE fails to deliver the best and most reliable estimates of population relationships (Lee & Song, 2004). In their simulation study, Lee & Song (2004) found that MLE generated unreliable estimates especially when sample size was approximately four or five times the number of estimated parameters. Even when sample data were normally distributed, Lee & Song (2004, p. 680) concluded that when sample size is small (i.e., 32, 48), "the ML approach is not recommended." Similarly, Zhang et al. (2007) conducted a methodological comparison of methods for analyzing growth models and, using data from the National Longitudinal Survey of Youth (NLSY), concluded that MLE yielded unreliable estimates and sub-optimal model fit when sample size was small (i.e., 20 subjects).

In both of these comparative studies an alternative statistical estimation approach—Bayesian analysis estimated via Markov Chain Monte Carlo (MCMC) methods—outperformed

MLE for fitting growth models under small sample conditions. Lee & Song (2004, p. 654) asserted that “the sampling-based Bayesian methods do not rely on asymptotic theory, and hence may be useful for situations with small samples.” And, furthermore, Zhang et al. (2007, p. 374) concluded that “these [Bayesian] methods are more plausible ways to analyze small sample data compared with the MLE method.” Especially relevant to longitudinal data, Rupp et al. (2004, p. 445) advocated persuasively for the use of Bayesian methods when analyzing multilevel data, writing, “Bayesian methods flex their muscles most strongly for these complex models.” Thus, although my sample size of 33 project teams is comparable to the sample sizes reported in recent published quantitative studies of team development (e.g., Mathieu & Schulze, 2006; Mathieu & Rapp, 2009), I chose to use Bayesian methods for analyzing my data and evaluating my theory of positive affect and project team development.

A Bayesian Approach to Growth Modeling

While a Bayesian approach to growth modeling adheres to the basic conceptualization for change over time described above (i.e., that change consists of a change intercept and a change slope), the estimation methods used to determine model parameters are very different and are grounded in a different statistical paradigm. Whereas traditional growth modeling approaches (i.e., MLE-based) rely on the asymptotic assumptions of a “frequentist” paradigm of statistical inference,⁴ a Bayesian approach to growth modeling relies on conditional probability analysis—most notably, Bayes’ theorem—to evaluate how *likely* or *probable* it is that a hypothesis or hypothesized model is true. Conceptually, Bayes’ theorem describes how new insights are combined with pre-existing beliefs to assess the

⁴Statisticians use the term “frequentist” when describing the statistical paradigm that is most widely used in the organizational behavior literature. The frequentist paradigm encompasses statistics such as the t, F, and χ^2 statistics. The term frequentist stems from the fundamental assumption underlying these tests that the true population value is equal to the value estimated by an infinite frequency of samples from the population. This assumption propagates through how one infers truth from sample data.

validity of a hypothesis. That is, Bayes' theorem provides a way to use new information—fresh data gathered in a research study, for instance—to update the degree to which one believed in, a priori, the validity of a given hypothesis or hypothesized model. In Bayesian terminology, the pre-existing belief (i.e., before one accounts for the new data) is referred to as the *prior* and the updated belief (i.e., after one accounts for the data) is referred to as the *posterior*. Mathematically, Bayes' theorem for non-discrete relationships is a conditional probability equation,

$$p(\theta|y) = \frac{p(\theta)p(y|\theta)}{p(y)} = \frac{p(\theta)p(y|\theta)}{\int_{\theta} p(\theta)p(y|\theta)d\theta} \quad (1)$$

where θ represents a model containing continuous parameters and y represents a set of data. Thus, the probability of the model before the data are considered (i.e., the *prior*) is denoted by $p(\theta)$ and the probability of the model after the data considered, or the probability of the model given the data (i.e., the *posterior*), is denoted by $p(\theta|y)$. The probability of the observed data given the hypothesized model—referred to as the *likelihood*—is represented by $p(y|\theta)$. Because the denominator of the equation is a normalizing constant, Bayes' theorem states that the posterior—the extent to which one believes in the hypothesized model after accounting for the new data—is equal to the prior multiplied by the likelihood. Or, said differently, the probability that a hypothesized model is valid is equal to one's prior belief in the hypothesis times the fit of the data to the hypothesized model. Table 2 summarizes the key differences between a Frequentist approach to growth modeling and a Bayesian approach, which I describe below in detail.

Table 2: Frequentist and Bayesian Approaches to Growth Modeling

	Frequentist Approach	Bayesian Approach
Model Characteristics		
Estimation method	Maximum likelihood	Gibbs sampler
Model convergence criterion	Usually an increase in the log likelihood less than or equal to a specified value	Judged by how well multiple Markov chains that started with different initial values “mix” or arrive at the same solution; $\hat{R}$ is an index of chain mixing.
Parameter Characteristics		
Point estimate	Value that maximizes the likelihood of the observed data	Mean of the posterior, median of the posterior
Standard error	Conceptually, the steepness of the curve of the likelihood function. Mathematically, the square root of the information matrix.	Conceptually, the variability of the posterior. Mathematically, the standard deviation of the posterior.
Significance	The parameter estimate divided by the standard error follows the t distribution	Not typically assessed, but a point estimate plus or minus 2 posterior standard deviations could be used

Interval	Confidence interval is interpreted to mean that if the study were repeated an infinite number of times and a confidence interval were constructed each time, $100 \times (1 - \alpha)\%$ of the intervals would contain the true parameter value	Credibility interval is interpreted to mean that the probability that the true parameter lies in the interval is $100 \times (1 - \alpha)\%$
Evaluation		
Strengths	Models can be fit quickly with widely-available software and solutions are excellent with large samples	Extremely flexible approach can estimate a wide range of models and generates the best solutions for small sample data; Interpretation of parameters is intuitive and one can incorporate relevant prior information
Weaknesses	Relies on asymptotic assumptions and, thus, yields biased estimates with small samples; assumptions limit the flexibility of models that can be fit	Computationally demanding; models can take a long time to converge

For longitudinal data structures, which are hierarchical in that repeated measures are nested within subjects, a Bayesian model constructs the prior for the lower-level model (i.e., the intra-subject model) using the information available in the higher-level model (i.e., the inter-subject model). For example, again consider my predictions regarding the relationship between, on the one hand, team trait positive affect, and on the other initial team friendship network density and growth in team friendship network density. In a Bayesian growth model, the lower-level, within-team model is constructed using the parameters from the higher-level, between-team model as prior information. The structure of this model presumes that knowing the average initial friendship density across teams is useful information for understanding any single team's initial friendship density. And, similarly, this model presumes that knowing the average relationship between time and friendship density is useful information for estimating the relationship between time and friendship density for any single team.

Along with the conceptual differences between a traditional frequentist (i.e., MLE) approach and a Bayesian approach to growth modeling are practical differences in fitting, summarizing, and interpreting the results of analyses. Whereas the solution of a frequentist growth modeling is generated using an optimization algorithm—most frequently the Newton-Raphson algorithm—the solution of a Bayesian growth model is generated using stochastic Markov Chain Monte Carlo (MCMC) methods, such as the popular Gibbs sampling algorithm. In Gibbs sampling, each parameter value is iteratively fit conditional on the current values of all other parameters, starting from initial values. In a simple three-parameter model, for example, the first parameter to be estimated would be updated conditional on the values of the other two parameters at the end of the previous iteration (or from random initial values if it is the first iteration). The second parameter would be updated conditional on the current value of the first parameter and the value of the third parameter from the prior iteration. And, finally, the third parameter would be updated conditional

on the current values of the just-updated first and second parameters. If done across a very large number of iterations, this process of updating parameters based on the values of the other parameters yields a simulated observation from the posterior distribution. When the entire process is repeated many times, the Gibbs sampling method generates a sample distribution of simulated observations from the posterior distribution that can be used for making statistical inferences (Gelfand & Smith, 1990; Gelman et al., 2004). The relatively less stable samples generated during the *burn-in period*—the first few hundred iterations of the procedure—are typically excluded from the posterior distribution, which is instead composed of the simulated posterior datapoints generated after the Markov chains have converged.

Two separate pieces of diagnostic information are important for judging the utility of the simulated posterior distribution (i.e., the accuracy of the estimated solution). The first pertains to the convergence and mixing of the Markov chains. To assess the convergence or mixing of the Markov chains, a researcher can inspect plots of the iterative sequences of estimates to determine whether the chains have, at their conclusion, arrived at the same solution. Typically, these plots are highly variable during the burn-in period before settling and stabilizing around a particular value. Additionally, to assess the mixing of the multiple Markov chains that started at distinct initial values, a researcher can examine the *potential scale reduction factor*, $\hat{R}$, which is the square root of the variance of all chains divided by the average within-chain variance. When $\hat{R}$ for all parameters is less than 1.1, the separate chains have reached the same solution and, thus, the model has converged well (Gelman & Hill, 2007). The second piece of diagnostic information pertains to the fit of the model to the observed data. To assess model fit for a Bayesian growth model, a researcher can use the *mean deviance*, which is the deviance averaged across the simulated parameter values and also the *deviance information criterion* (DIC), which is conceptually similar to the *Akaike information criterion* (AIC) in that it adjusts the deviance for the number of parameters that

are estimated in the model. These values are useful, like in maximum likelihood models, for model comparison and selecting the best model for the data. Lower values for both the mean deviance and the DIC indicate better fit of the model to the data.

To draw inferences about hypotheses and/or a hypothesized model a researcher can summarize the information contained in the simulated posterior distribution in a few ways. First, point estimates are often used to represent the expected value of a given parameter. The most commonly-used point estimate is the *posterior mean*, which is the arithmetic mean of the simulated posterior distribution for a given parameter. The posterior mean and the *posterior standard deviation*—the standard deviation of the simulated posterior distribution for a given parameter—can together be used in ways similar to the parameter estimate and standard error generated by a traditional frequentist approach to growth modeling. In addition to the point estimate and its standard deviation, researchers typically use a *credibility interval* to summarize the posterior distribution and make statistical inferences. Though similar in use to the confidence interval of the frequentist paradigm, a posterior credibility interval is interpreted differently. In the frequentist paradigm, a confidence interval of 95% indicates that if a study is repeated an infinite number of times and a confidence interval is calculated for each study, 95% of the confidence intervals will contain the true parameter value. In the Bayesian paradigm, a credibility interval of 95% indicates that there is a 95% probability that the true parameter value, given the observed data, lies within the boundaries of the interval. The lower and upper bounds of a credibility interval are calculated directly from the simulated posterior distribution.

With a team-level sample size of 33 and given the results of recent simulation-based studies (e.g., Lee & Song, 2004; Zhang et al., 2007), I thus chose to use a Bayesian approach to growth modeling to evaluate my hypotheses, even though Bayesian modeling is rare in the teams literature, because such an approach provides better solutions for small sample data. However, because a Frequentist approach to such analyses is most common

the team development literature, I provide in Appendix A the results of mirrored analyses using a maximum likelihood-based approach. The results of these analyses are largely consistent with the findings that I report below.

A Model-Building Framework for Longitudinal Analysis

Using a Bayesian approach, I followed a model-building framework to analyze my data and examine my hypotheses about change over time in line with the recommendations of organizational scholars (e.g., Bliese & Ployhart, 2002) and statisticians (e.g., Gelman & Hill, 2007) alike for effective analysis of longitudinal data. In a model-building framework, one first fits a series of models of increasing complexity to the data simply to determine the general growth structure. In this first step, predictor variables are excluded from the model and the primary goal is to understand the nature (e.g., invariant trajectory across teams, varying change intercept, varying change slope, etc.) and form (e.g., linear, quadratic) of the growth trajectory (Bliese & Ployhart, 2002). After identifying the best-fitting model for the base growth trajectory—which I call the “Base Model”—one examines specific predictors of the components of the trajectory. I refer to this second step as the “Prediction Model.” To evaluate fit in determining the appropriate Base Model for each growth trajectory, I examined the change in model fit (i.e., mean deviance, DIC) as I increased the complexity of the model along with the estimate of fixed parameters for representing the form of change (e.g., linear, quadratic). To evaluate the importance of specific parameter estimates in the Prediction Model, I examined the posterior mean, posterior standard deviation, and 95% credibility interval, following the recommendations of Bayesian statisticians (Gelman & Hill, 2007).

Analytical Approach for Evaluating Hypotheses about Team Effectiveness

Finally, I used path modeling, estimated using Bayesian methods, to examine my hypotheses about team effectiveness. Because of both the size of my sample and the complexity of my overall theoretical model, I constructed path models using a two-stage approach. First, and similar to the approach used by (Chen, 2005) in his study of newcomer growth trajectories and performance, I extracted the Bayesian estimators for the change intercept and the change slope from the Base Model for each growth trajectory. The Bayesian estimators provide, for each team, an estimate of (a) where the team starts (i.e., the change intercept) and (b) how the team changes over time (i.e., the change slope). Second, I used the extracted growth trajectory parameters as variables in Bayesian path models. As described above, I used a Bayesian approach to estimate the path models due to the relatively more accurate estimates produced by Bayesian estimation relative to maximum likelihood estimation. Because of the large number of parameters in a combined test of all growth trajectories at once, I modeled each trajectory separately. While I do report the results of an integrated model (i.e., a model that includes trajectories for routine development, friendship, and efficacy), the large number of parameters in this model makes the model inherently unstable given my team-level sample size. In predicting team effectiveness, I controlled for team experience (i.e., the extent to which team members had participated in the competition in prior years), team formation activity (i.e., how many meetings the team had during the initial formation phase), and team ability (i.e., the average combined GPA—military, athletic, and academic—of team members).

Results

Table 3 reports team-level means, standard deviations, and intercorrelations among study variables; multiple values are provided for variables measured at multiple points in time. Based on the zero-order correlations, highly effective teams (as assessed by their score in the military competition) were more experienced ($r = 0.47, p < .01$), had leaders with higher trait positive affect ($r = 0.43, p < .05$), were higher in team trait positive affect ($r = 0.56, p < .01$), had denser friendship networks (Mean r across time = $0.41, p < .05$), and higher team efficacy (Mean r across time = $0.51, p < .01$) than their less effective counterparts. In addition to its relationship with team effectiveness, there were interesting and significant correlations between team trait positive affect and a number of other variables. Team trait positive affect was positively correlated with friendship network density at Time 1 ($r = 0.43, p < .05$) and Time 3 ($r = 0.42, p < .05$) and with team efficacy at Time 1 ($r = 0.47, p < .01$), Time 2 ($r = 0.36, p < .05$), and Time 3 ($r = 0.37, p < .05$). While the zero-order correlations between team trait positive affect and team learning behavior at times 1, 2, and 3 were not statistically significant, the change in the sign of the correlations across time was consistent with my hypotheses regarding team trait positive affect and team routine development; at Time 1 the correlation was positive, but at Times 2 and 3 the correlation was negative. Of the variables measured at multiple points in time, team learning behavior was the only one for which the cross-temporal correlations with team trait positive affect were not all positive.

Table 3: Means, Standard Deviations, and Intercorrelations of Study Variables^{abc}

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8
1. Team ability (T0)	3.59	0.26	—							
2. Team experience (T0)	0.77	0.24	0.13	—						
3. Team formation activity (T0)	3.42	0.34	−0.23	0.14	—					
4. Leader trait positive affect (T0)	4.09	0.59	0.20	0.10	−0.06	(0.89)				
5. Team trait positive affect (T0)	3.81	0.25	0.26	0.12	0.08	0.79	(0.94)			
6. Team positive mood (T1)	3.86	0.28	0.24	0.22	0.09	0.37	0.38	(0.88)		
7. Team positive mood (T2)	3.86	0.35	0.20	0.39	−0.11	0.04	0.22	0.48	(0.94)	
8. Team positive mood (T3)	3.87	0.36	0.25	0.16	0.02	0.28	0.22	0.44	0.55	(0.90)
9. Exploratory Search (T1)	3.09	0.44	−0.13	0.15	−0.04	0.37	0.22	0.32	0.29	0.35
10. Exploratory Search (T2)	3.28	0.4	−0.33	−0.06	−0.04	0.01	−0.14	0.23	0.06	0.27
11. Exploratory Search (T3)	3.12	0.5	−0.32	−0.09	0.34	−0.14	−0.23	−0.06	−0.29	0.05
12. Exploitative Refining (T1)	3.92	0.42	0.36	0.27	−0.14	0.53	0.47	0.40	0.51	0.31
13. Exploitative Refining (T2)	4.15	0.36	0.15	0.33	−0.14	0.23	0.33	0.28	0.68	0.41
14. Exploitative Refining (T3)	4.26	0.31	0.05	−0.07	0.20	0.10	0.26	0.08	0.26	0.48
15. Friendship network density (T1)	2.96	0.31	0.02	0.22	0.16	0.37	0.43	0.48	0.14	0.10
16. Friendship network density (T2)	3.1	0.38	0.15	0.19	−0.12	0.12	0.28	0.56	0.54	0.18
17. Friendship network density (T3)	3.16	0.34	0.05	0.15	0.12	0.21	0.42	0.54	0.26	0.12
18. Team efficacy (T1)	3.75	0.75	0.40	0.42	−0.09	0.36	0.47	0.43	0.59	0.22
19. Team efficacy (T2)	3.74	0.72	0.31	0.39	−0.10	0.20	0.36	0.36	0.61	0.30
20. Team efficacy (T3)	3.99	0.72	0.20	0.35	0.10	0.26	0.37	0.21	0.53	0.30
21. Team effectiveness (T4)	614.73	66.57	0.22	0.47	−0.04	0.43	0.56	0.28	0.41	0.20

^a Team-level N = 33 except for relationships with leader trait positive affect, where N = 30.

^b Where N = 33, for correlations $|.34|, p < .05$; $|.44|, p < .01$. Where N = 30, for correlations $|.36|, p < .05$; $|.46|, p < .01$, two-tailed.

^c For multi-item scales, interitem reliability is in parentheses along the diagonal.

Table 3: Means, Standard Deviations, and Intercorrelations of Study Variables^{abc} (continued)

	9	10	11	12	13	14	15
1. Team ability (T0)							
2. Team experience (T0)							
3. Team formation activity (T0)							
4. Leader trait positive affect (T0)							
5. Team trait positive affect (T0)							
6. Team positive mood (T1)							
7. Team positive mood (T2)							
8. Team positive mood (T3)							
9. Exploratory Search (T1)	(0.92)						
10. Exploratory Search (T2)	0.66	(0.91)					
11. Exploratory Search (T3)	0.22	0.54	(0.94)				
12. Exploitative Refining (T1)	0.39	-0.16	-0.50	(0.90)			
13. Exploitative Refining (T2)	0.29	-0.07	-0.46	0.66	(0.92)		
14. Exploitative Refining (T3)	0.08	-0.09	-0.02	0.17	0.47	(0.86)	
15. Friendship network density (T1)	0.14	0.22	0.14	0.01	-0.07	-0.02	—
16. Friendship network density (T2)	0.18	0.17	-0.13	0.13	0.15	0.08	0.65
17. Friendship network density (T3)	0.18	0.18	0.12	-0.08	0.01	0.17	0.68
18. Team efficacy (T1)	0.50	0.16	-0.19	0.52	0.38	-0.05	0.42
19. Team efficacy (T2)	0.48	0.19	-0.07	0.44	0.44	-0.01	0.37
20. Team efficacy (T3)	0.47	0.11	-0.12	0.46	0.56	0.27	0.24
21. Team effectiveness (T4)	0.22	-0.01	0.02	0.27	0.24	0.05	0.39

^a Team-level N = 33 except for relationships with leader trait positive affect, where N = 30.

^b Where N = 33, for correlations $|.34|, p < .05$; $|.44|, p < .01$. Where N = 30, for correlations $|.36|, p < .05$; $|.46|, p < .01$, two-tailed.

^c For multi-item scales, interitem reliability is in parentheses along the diagonal.

Table 3: Means, Standard Deviations, and Intercorrelations of Study Variables^{abc} (continued)

	16	17	18	19	20	21
1. Team ability (T0)						
2. Team experience (T0)						
3. Team formation activity (T0)						
4. Leader trait positive affect						
5. Team trait positive affect						
6. Team positive mood (T1)						
7. Team positive mood (T2)						
8. Team positive mood (T3)						
9. Exploratory Search (T1)						
10. Exploratory Search (T2)						
11. Exploratory Search (T3)						
12. Exploitative Refining (T1)						
13. Exploitative Refining (T2)						
14. Exploitative Refining (T3)						
15. Friendship network density (T1)						
16. Friendship network density (T2)	—					
17. Friendship network density (T3)	0.77	—				
18. Team efficacy (T1)	0.45	0.30	—			
19. Team efficacy (T2)	0.33	0.29	0.89	—		
20. Team efficacy (T3)	0.17	0.22	0.71	0.79	—	
21. Team effectiveness (T4)	0.39	0.46	0.54	0.55	0.43	—

^a Team-level N = 33 except for relationships with leader trait positive affect, where N = 30.

^b Where N = 33, for correlations $|.34|, p < .05$; $|.44|, p < .01$. Where N = 30, for correlations $|.36|, p < .05$; $|.46|, p < .01$, two-tailed.

^c For multi-item scales, interitem reliability is in parentheses along the diagonal.

Figure 2: Developmental Trajectories in 33 Project Teams

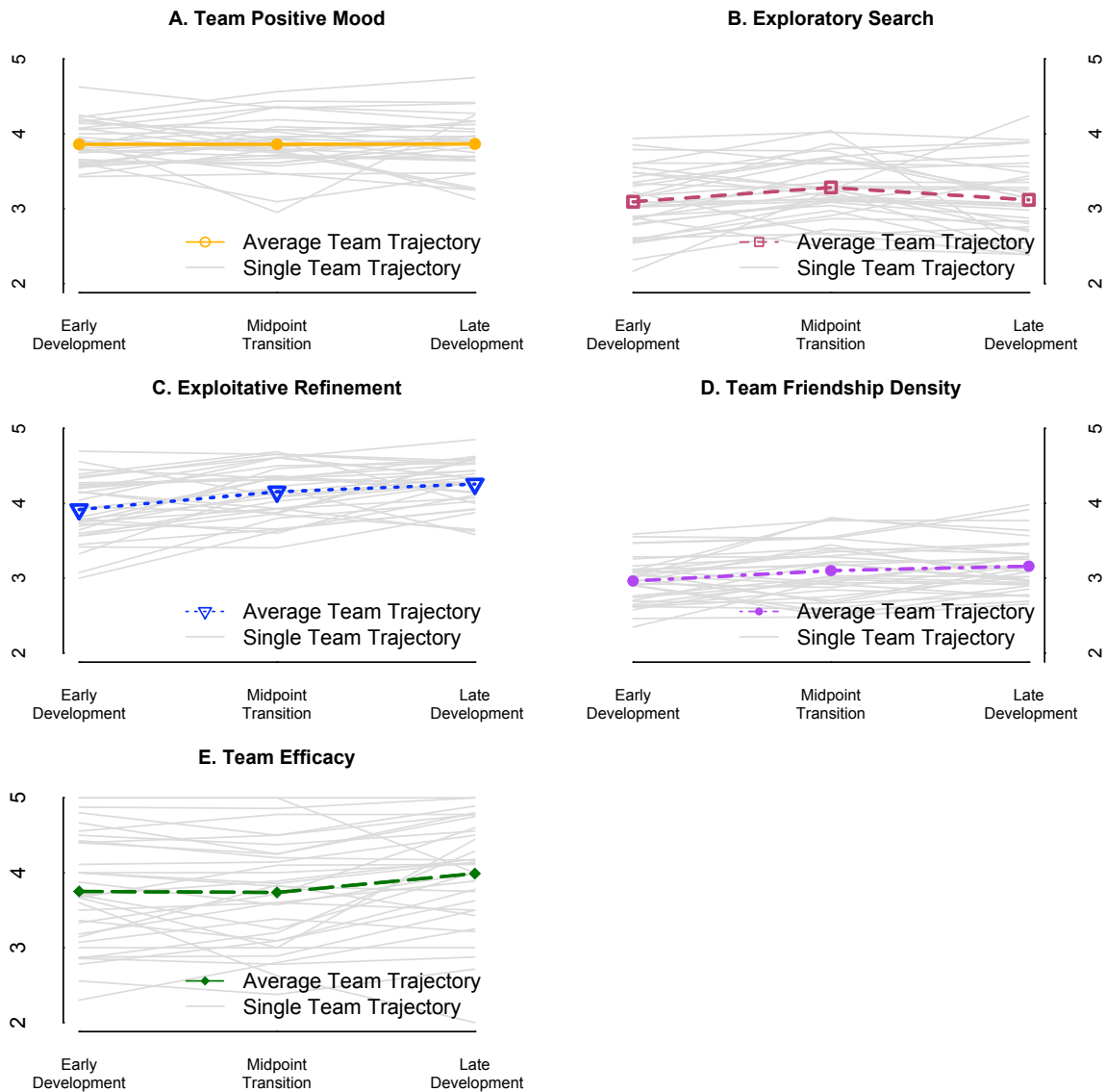


Figure 2 presents plots of the growth trajectories of team positive mood, team learning behavior, team friendship network density, and team efficacy. As can be seen in the upper left panel, the average growth trajectory across teams for team positive mood was flat, suggesting that, at least on average, project teams maintain a steady level of positive mood across time. In contrast, the average growth trajectory for team learning behavior was

curvilinear; teams on average increased their learning behavior from the early development phase to the midpoint transition, but then decreased learning behavior from the midpoint transition through late development. On average, project teams increased over time in friendship density and team efficacy, as depicted in plots C and D of Figure 2.

The Emergence of Team Trait Positive Affect during Team Formation

Hypotheses 1 through 4 examined the emergence and construct validity of team trait positive affect. In Hypothesis 1 I proposed that project teams are relatively homogeneous in team members' trait positive affect. This hypothesis was supported by results reported above regarding the appropriateness of using the team mean across individual team members to operationalize team-level consensus constructs. As can be seen in Table 1 on page 66, the intraclass correlation coefficient for trait positive affect by team membership was significant [$ICC(1) = 0.08, p < .01$], with team membership accounting for approximately 8% of the variance in members' trait positive affect. Focusing specifically on within-team agreement, there was substantial homogeneity within teams in trait positive affect. The average team $r_{wg(j)}$ value was 0.94 ($SD = 0.03$) and all 33 teams' $r_{wg(j)}$ values were well above the commonly-used standard of 0.70 (Chen et al., 2004); indeed, all values exceeded 0.85. Thus, the data supported Hypothesis 1; teams were relatively homogeneous in team members' trait positive affect.

In Hypothesis 2 I proposed that one source of homogeneity in team members' trait positive affect is members' attraction to and selection by an affectively similar project team leader. In support of this hypothesis, the bivariate correlation between team leader trait positive affect and team trait positive affect was positive, strong, and significant ($r = .67, p < .01$). Testing this hypothesis using a more sophisticated approach, I used multilevel model-

ing and regressed individual team member trait positive affect on team leader trait positive affect, allowing the intercept of the regression equation to vary across teams. Consistent with the results of the bivariate correlation, there was a significant, positive and strong relationship between leader trait positive affect and team member trait positive affect ($B = 0.35, p < .01$). Hypothesis 2 was thus supported by the data.

I proposed in Hypotheses 3 and 4, respectively, that team trait positive affect is positively related to team positive mood and, moreover, that teams experience a relatively consistent level of team positive mood across time. The plot of team positive mood over time in plot A of Figure 2 suggested that, at least on average, team positive mood is stable across time. The plot also suggested that there was meaningful variance across teams in team positive mood; the light grey lines representing individual team trajectories were spread across the vertical axis. To statistically evaluate these hypotheses, I constructed a Bayesian growth model in which team positive mood, measured at three points in time (i.e., during early development, during the midpoint transition, and during late development), was regressed on team trait positive affect (measured during team formation) and on time. Table 4A provides model fit statistics for a series of growth models of increasing complexity, following Bliese and Ployhart's (2002) recommended model-building approach to longitudinal analysis, to determine the best base growth model for team positive mood.

Table 4: Results of Bayesian Models Used to Determine Base Growth Trajectories^{ab}

	A. Positive Mood		B. Exploratory Search		C. Exploitative Refining	
	Deviance	DIC	Deviance	DIC	Deviance	DIC
1. Linear trend ^c	62.7	65.6	125.7	128.5	81.2	84.1
2. Quadratic trend ^d	67.7	67.7	123.4	127.3	81.4	85.2
3. Random change intercept ^e	−1.9	24.7	65.9	92.6	27.6	52.7
4. Random change slope ^f	−11.3	21.2	−13.9	39.9	−28.0	17.9
Selected Base Model	Model 3, Linear		Model 4, Quadratic		Model 3, Linear	

	D. Friendship Density		E. Team Efficacy	
	Deviance	DIC	Deviance	DIC
1. Linear trend ^c	70.7	73.6	219.7	222.5
2. Quadratic trend ^d	71.7	75.8	220.1	224.1
3. Random change intercept ^e	−45.6	−14.7	67.3	99.3
4. Random change slope ^f	−49.8	−15.1	31.0	77.6
Selected Base Model	Model 3, Linear		Model 4, Linear	

^a Team-level N = 33 × 3 time points.^b Values are the model mean posterior deviance and the deviance information criterion (DIC) for judging model fit.^c Linear trend model contains a fixed linear effect of time.^d Quadratic trend model adds a fixed quadratic effect of time.^e Random change intercept model allows the initial value of the criterion to vary across teams.^f Random change slope model allows the linear relationship between time and the criterion to vary across teams.

I first fit a model with a linear effect of time on team positive mood to the data, with no varying change intercept or change slope (Table 4A, Model 1). A fixed quadratic parameter for the time function (Table 4A, Model 2) was not meaningfully different from zero, indicating that the relationship between time and team positive mood was linear; thus, I chose a linear time form for team positive mood. Allowing the linear change intercept to vary across teams (Table 4A, Model 3) did improve model fit relative to the base linear model (Δ deviance = -64.8), indicating that there was meaningful variance across teams in team positive mood at the first measurement point, which was during early team development. Allowing the linear change slope to vary across teams (Table 4A, Model 4) resulted in a slight improvement of model fit (Δ deviance = -9.0) relative to the varying intercept model. The improvement in out-of-sample prediction by adding the varying intercept effect and the covariance between the varying intercept and the varying slope was, however, minimal (Δ DIC = -2.6). As such, I concluded that, the relationship between time and team positive mood is invariant across teams and that the best model for representing the change trajectory for team positive mood is a model in which only the change intercept varied across teams. I used this selected model to test the relationship between team trait positive affect and team positive mood across time.

Table 5: Results of Bayesian Growth Models Examining Hypotheses 1 through 4 Regarding Team Positive Mood over Time^{abc}

	A. Base Model				B. Prediction Model			
	Mean	SD	2.5%	97.5%	Mean	SD	2.5%	97.5%
Initial positive mood	3.86	0.06	3.74	3.96	3.86	0.05	3.75	3.97
Time	0.00	0.03	-0.05	0.06	0.00	0.03	-0.06	0.06
Team trait positive affect					0.37	0.20	-0.00	0.76
σ^2 , intercept	0.24	0.04	0.17	0.33	0.23	0.04	0.15	0.32
σ^2 , residual	0.24	0.02	0.20	0.29	0.24	0.02	0.21	0.29
R_y^2	0.47				0.47			
$R_{intercept}^2$					0.12			
Deviance	-1.86				-1.36			
DIC	24.73				24.92			

^a Team-level N = 33 × 3 time points.

^b Team positive mood across time is the criterion.

^c Values are posterior means, standard deviations, and 95% credibility intervals.

Table 5 presents detailed results from Bayesian growth models used to test the relationship between team trait positive affect and team positive mood across time. The Base Model in Table 5 provides detail on the relationship, without team trait positive affect in the model, between time and team positive mood. On average, teams were relatively high in team positive mood (Posterior $\bar{X} = 3.86$, $SD = 0.06$) at the first measurement point (i.e., during early development). There was a null relationship between time and team positive mood (Posterior $\bar{X} = 0.00$, $SD = 0.03$), indicating that on average teams were stable in positive mood across time. The null effect of time on team positive mood, combined with the lack of meaningful variance across teams in this relationship, provides support for Hypothesis 4 that team positive mood is relatively stable across time.

The Prediction Model of Table 5 presents the results of a model incorporating team trait positive affect as a predictor of initial team positive mood. There was a moderately strong, positive relationship between team trait positive affect and initial team positive mood (Posterior $\bar{X} = 0.37$, $SD = 0.20$), such that teams high in team trait positive affect reported high team positive mood during the early development period. Team trait positive affect explained 12% of the variance in initial team positive mood and, with a null relationship between time and team positive mood, the data suggest that this relationship holds across measurement periods in support of Hypothesis 3.

Together, the results of these analyses supported my hypotheses regarding the formation and nature of team trait positive affect, conceptualized as a stable, consensus construct. Team leaders tend to assemble teams with a level of team trait positive affect that matches their own trait positive affect. And, furthermore, team trait positive affect is positively related to the degree to which teams experiences shared positive moods consistently across time.

Team Trait Positive Affect and the Development of Team Task Routines over Time

I predicted in Hypotheses 5 through 7 that team trait positive affect is related to how project teams develop task routines across time by shaping the degree to which team members focus, at different stages of team life, on looking for new ways of completing their tasks through exploratory search versus implementing and incrementally improving existing solutions through exploitative refining. As plots B and C of Figure 2 on page 84 show, project teams in my sample appeared to vary in their developmental trajectories of both exploratory search and exploitative refining. The average trajectory for exploratory search over time, presented in plot B of Figure 2, appeared quadratic such that exploratory search increased from early development to the midpoint transition, but then decreased from the midpoint through late development. In contrast, the average trajectory for exploitative refining (plot C) appeared linear and increasing across all three phases of development. Based on the plots, there appeared to be greater variance across teams in exploratory search compared to exploitative refining.

In Hypotheses 5 and 6, I posited that team trait positive affect shapes how teams engage in exploratory search over time. To investigate my hypotheses about change in exploratory search, I first ran a series of growth models to determine the optimal base growth trajectory. Table 4B on page 87 presents the results of a series of Bayesian growth models used to determine the appropriate base model for the exploratory search trajectory. Following Bliese and Ployhart's (2002) framework, after finding a linear effect of time on exploratory search in Model 1, I added a fixed quadratic effect of time (i.e., Model 2). Because the parameter estimate for the fixed quadratic effect was meaningfully different from zero, I concluded that Model 2, containing both a linear and a quadratic effect of time, was preferable to Model 1. Allowing the change intercept to vary (i.e., Model 3) yielded a

substantial improvement in model fit (Δ deviance = -57.5) from a model with only fixed effects, suggesting that there was significant variance in the extent to which teams engaged in exploratory search during early development. With the meaningful intercept variance, I proceeded to allow the linear change slope to vary across teams. The results of this model, presented as Model 4 of Table 4B indicated that teams varied in their linear change across time in exploratory search.⁵ Thus, I selected as the base growth model for exploratory search a model with a random change intercept and a random linear change slope, as well as a fixed quadratic trend. According to this model, teams in general follow a quadratic path in exploratory search over time, but teams vary in (a) the extent to which they engage in exploratory search during early development and (b) the extent to which they change in exploratory search over time.

⁵In results not presented in Table 4B, allowing the quadratic trend to vary across teams did not improve model fit.

Table 6: Results of Bayesian Growth Models Examining Hypotheses 5 and 6 Regarding Exploratory Search over Time^{abc}

	A. Base Model				B. Prediction Model			
	Mean	SD	2.5%	97.5%	Mean	SD	2.5%	97.5%
Initial exploratory search	3.09	0.09	2.92	3.25	3.09	0.09	2.92	3.25
Time, linear	0.37	0.12	0.14	0.60	0.38	0.12	0.14	0.60
Time, quadratic	-0.18	0.05	-0.28	-0.07	-0.18	0.05	-0.28	-0.08
Team trait positive affect					0.26	0.36	-0.47	1.00
Time $\times$ Team trait positive affect					-0.41	0.22	-0.84	0.03
σ^2 , intercept	0.41	0.07	0.28	0.56	0.41	0.07	0.28	0.56
σ^2 , slope	0.25	0.05	0.15	0.36	0.23	0.06	0.10	0.34
$r_{intercept,slope}$	-0.49	0.20	-0.78	-0.03	-0.47	0.21	-0.78	0.05
σ^2 , residual	0.23	0.03	0.18	0.31	0.23	0.03	0.18	0.32
R_y^2	0.74				0.74			
$R_{intercept}^2$					-0.00			
R_{slope}^2					0.13			
Deviance	-12.99				-10.51			
DIC	40.28				41.91			

^a Team-level N = 33 $\times$ 3 time points.

^b Exploratory search across time is the criterion.

^c Values are posterior means, standard deviations, and 95% credibility intervals.

Table 6 presents the detailed results of the Base Model for the growth of exploratory search over time. On average, teams showed a moderate focus on exploratory search during early development (Posterior $\bar{X} = 3.09$, SD = 0.07), though there was substantial variance across teams in initial exploratory search (Posterior $\bar{X} = 0.41$, SD = 0.07). On average, there was a positive linear relationship between time and exploratory search (Posterior $\bar{X} = 0.37$, SD = 0.12) and a negative quadratic relationship (Posterior $\bar{X} = -0.18$, SD = 0.05), indicating that teams, on average, increased their focus on exploratory search from early development to the midpoint transition, but then decreased this focus from the midpoint through late development. There was, however, meaningful variation in the linear effect of time on exploratory search (Posterior $\bar{X} = 0.25$, SD = 0.05). Initial exploratory search (i.e., the change intercept) and change in exploratory search over time (i.e., the change slope) were moderately and negatively correlated (Posterior $\bar{X} = -0.48$, SD = 0.20); as initial exploratory search increased, the extent to which a team increased its focus on exploration over time decreased.

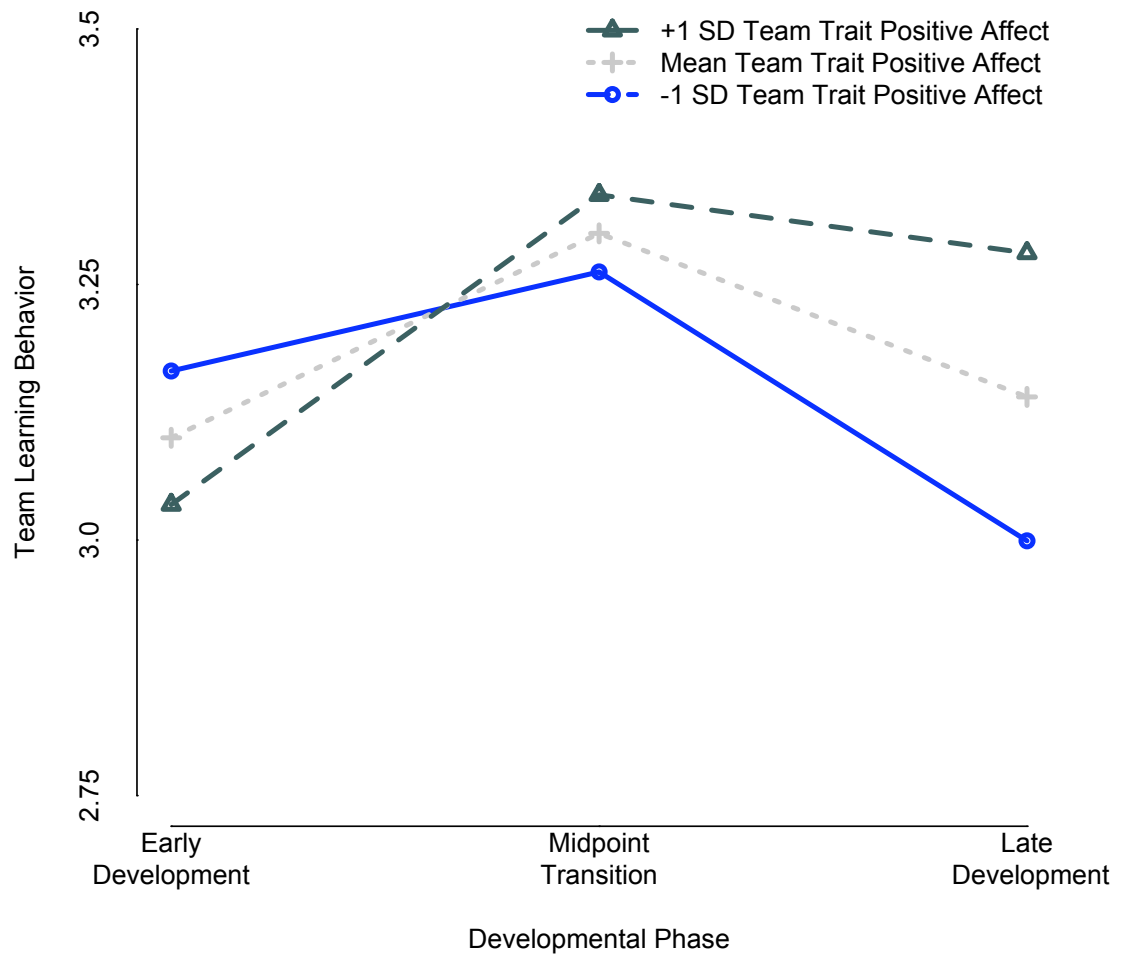
Because there was significant variance in both the change intercept and the change slope, I proceeded to test Hypotheses 5 and 6 regarding the relationship between team trait positive affect and exploratory search change over time. In Hypothesis 5 I posited that team trait positive affect broadens team members' perspectives, enhances psychological safety, and increases communication among team members during early development; for these reasons, I predicted that team trait positive affect increases exploratory search during early development. The Prediction Model of Table 6 presents the results of Bayesian growth models investigating the relationship between team trait positive affect and the growth trajectory of exploratory search. The relationship between team trait positive affect and the change intercept for exploratory search was on average positive (Posterior $\bar{X} = 0.26$), but the posterior standard deviation was large relative to the effect (SD = 0.36) and team trait positive affect did not account for any of the variance in initial exploratory search. Thus,

Hypothesis 5 was not supported.

In Hypothesis 6 I predicted that team trait positive affect, because of links to satisficing behavior, would be negatively related to growth over time in exploratory search. With the signal of the midpoint transition, I reasoned, teams high in team trait positive affect would select solutions and approaches that were “good enough,” while teams low in team trait positive affect would exhibit maximizing behaviors and continue to search for the optimal ways of completing their tasks. To test this hypothesis, I examined the interaction between team trait positive affect and the linear effect of time on exploratory search; this interaction represents the degree to which team trait positive affect moderates the relationship between time and exploratory search. As can be seen in the Prediction Model of Table 6, the interaction term was negative and non-zero (Posterior $\bar{X} = -0.41$, $SD = 0.22$), indicating that team trait positive affect weakened the relationship between time and exploratory search. Team trait positive affect accounted for approximately 13% of the variance in the exploratory search change slope. To further examine the nature of the interaction, I plotted the predicted values for exploratory search across time for team trait positive affect at its mean, plus one standard deviation, and minus one standard deviation.

Figure 3 depicts the interaction between team trait positive affect and time in predicting exploratory search. During early development, teams high in team trait positive affect exhibited slightly higher exploratory search than teams low in team trait positive affect. From early development to the midpoint transition, both teams high in team trait positive affect and teams low in team trait positive affect exhibited increased increasing exploratory search, though teams lower in team trait positive affect exhibited a sharper increase. At the midpoint, there were trivial differences between teams high in positive affect and teams low in positive affect. However, from the midpoint transition through late development, teams high in team trait positive affect exhibited a sharp decrease in exploratory search, while teams low in team trait positive affect sustained their level of exploratory search from the

Figure 3: Effect of Team Trait Positive Affect on Exploratory Search Change over Time



midpoint transition through late development. In short, and consistent with Hypothesis 6, after the midpoint transition teams high in team trait positive affect closed down exploratory search, while teams low in team trait positive affect continued to search for new ways of completing their tasks. Thus, the data supported Hypothesis 6.

For the same theoretical reasons underlying my hypotheses about exploratory search, I proposed in Hypothesis 7 that team trait positive affect is positively related to growth in exploitative refining over time. Table 4C on page 87 presents the results of a series of models used to determine the appropriate base model for the growth trajectory of exploitative refining over time. As expected, based on the plot of the data, a fixed quadratic effect of time (i.e., in Model 2) was not meaningfully different from zero, indicating that the optimal form of the change trajectory for exploitative refining was a linear one. Allowing the change intercept to vary (i.e., Model 3) yielded a substantial improvement in model fit (Δ deviance = -53.8), indicating that there was meaningful variance in the extent to which teams engaged in exploitative refining during the early development phase of project team life. Allowing the linear change slope to vary across teams (i.e., Model 4) resulted in a further improvement in model fit (Δ deviance = -55.6), suggesting that teams varied in the amount of linear change in exploitative refining they reported over time. Thus, I selected as the base growth model for exploitative refining a model with a random change intercept and a random change slope. According to this model, teams in general follow a linear path in exploitative refining over time, but teams vary in (a) the extent to which they engage in exploitative refining during early development and (b) the extent to which they change in exploitative refining over time.

Table 7: Results of Bayesian Growth Models Examining Hypothesis 7 Regarding Exploitative Refining over Time^{abc}

	A. Base Model				B. Prediction Model			
	Mean	SD	2.5%	97.5%	Mean	SD	2.5%	97.5%
Initial exploitative refining	3.94	0.07	3.80	4.09	3.94	0.07	3.79	4.08
Time, linear	0.17	0.04	0.09	0.25	0.17	0.04	0.09	0.25
Team trait positive affect					0.71	0.32	0.10	1.31
Time $\times$ Team trait positive affect					-0.17	0.18	-0.53	0.18
σ^2 , intercept	0.38	0.07	0.26	0.52	0.35	0.07	0.22	0.48
σ^2 , slope	0.18	0.05	0.07	0.27	0.18	0.05	0.07	0.27
$r_{intercept,slope}$	-0.73	0.13	-0.93	-0.43	-0.72	0.15	-0.92	-0.38
σ^2 , residual	0.21	0.03	0.16	0.28	0.21	0.03	0.16	0.28
R_y^2	0.70				0.69			
$R_{intercept}^2$					0.17			
R_{slope}^2					0.04			
Deviance	-27.16				-26.33			
DIC	19.44				20.03			

^a Team-level $N = 33 \times 3$ time points.

^b Exploitative refining across time is the criterion.

^c Values are posterior means, standard deviations, and 95% credibility intervals.

Table 7 presents the detailed results of the Base Model for the growth of exploitative refining over time. On average, teams showed a high focus on exploitative refining even during early development (Posterior $\bar{X} = 3.94$, $SD = 0.07$), though there was meaningful variance across teams this change intercept for exploitative refining (Posterior $\bar{X} = 0.38$, $SD = 0.07$). On average, there was a positive linear relationship between time and exploitative refining (Posterior $\bar{X} = 0.17$, $SD = 0.04$), indicating that teams, on average, increased their focus on exploitative refining in a consistent, linear fashion over the course of project team life. There was, however, meaningful variation in the linear effect of time on exploitative refining (Posterior $\bar{X} = 0.18$, $SD = 0.05$). Initial exploitative refining (i.e., the change intercept) and change in exploitative refining over time (i.e., the change slope) were negatively correlated (Posterior $\bar{X} = -0.73$, $SD = 0.13$), reflecting potential ceiling effects in the measure of exploitative refining; as initial exploitative refining increased, the extent to which a team increased its focus on exploitative refining over time decreased.

Because there was significant variance the change slope, I proceeded to examine Hypothesis 7, in which I predicted that team trait positive affect is positively related to growth in exploitative refining over time. The Prediction Model of Table 7 presents the results of Bayesian growth models investigating the relationship between team trait positive affect and the growth trajectory of exploitative refining. Although not something that I predicted, the relationship between team trait positive affect and the change intercept for exploitative refining was positive and non-zero (Posterior $\bar{X} = 0.71$, $SD = 0.32$). Teams high in team trait positive affect exhibited higher levels of exploitative refining than teams low in team trait positive affect in the earliest days of team life. Unexpectedly, the relationship between team trait positive affect and the change slope of exploitative refining was not significant (Posterior $\bar{X} = -0.17$, $SD = 0.18$). Thus, Hypothesis 7 was not supported. Together, these effects indicate that teams high in team trait positive affect engage in a higher level of exploitative refining behavior over time than teams low in team trait positive affect, as they

start higher during early development all teams, on average, increase over time in a linear fashion.

Summarizing my findings regarding the relationship between team trait positive affect and the development of task routines over time, I found very weak evidence that team trait positive affect is positively associated with increased exploratory search during early development; rather, I found that teams high in team trait positive affect exhibit a relatively higher level of exploitative refining during early development. And yet, I found strong evidence that team trait positive affect is related to a pattern of exploratory search over time such that teams high in team trait positive affect close down their focus on exploration and searching for new ways of completing their tasks after the midpoint transition. In contrast, teams low in team trait positive affect sustain their exploratory search efforts through continued team learning behavior even as the project deadline is near. The picture of task routine development that emerges from my analyses, consistent with my theory, is one in which teams high in team trait positive affect steadily improve their fitness in incremental ways, but restrict exploratory search to the early periods of their development. Teams low in team trait positive affect, on the other hand, report overall lower levels of exploitative refinement over time and continue to search in explorative ways even as project team life winds down.

Team Trait Positive Affect and the Development of Friendship Network Density over Time

Plot D of Figure 2 on page 84 shows individual project team trajectories and the average team trajectory for the development of team friendship network density over time. Relative to the plot of team learning behavior (i.e., Plot B), there appeared to be less variance in both the change intercept and the change slope for friendship network density. And, although

there was a slight linear increase in average friendship network density over time, the increase over time appeared small. The results of Bayesian growth models, as presented in Table 4.4D confirmed what the plot of the data suggested. A linear trend for team friendship network density was significant (i.e., Model 1), while the quadratic trend was not (i.e., Model 2). On average, change in team friendship network density was of a linear form across time. Allowing the change intercept to vary (i.e., Model 3) yielded a substantial improvement in model fit (Δ deviance = -117.3) relative to a model with only a fixed linear effect, indicating that project teams differed in friendship network density during early development. Allowing the change slope to vary across, however, teams did not meaningfully improve the fit of the model (Δ deviance = -4.2), suggesting that teams differed little in the extent to which they changed in friendship network density over time. Thus, while inconsistent with my theoretical model that presumed variance in the team friendship network density change slope, I selected as a base model for the development of friendship network density a model with a linear time trend and a varying change intercept.

Table 8 presents detailed results for this base model. Teams were, on average, moderately dense in friendship relationships during early development (Posterior $\bar{X} = 2.98$, SD = 0.06); there was, however, significant variance in friendship network density during early development (Posterior $\bar{X} = 0.30$, SD = 0.04). Over the course of team development, project teams increased marginally in friendship network density (Posterior $\bar{X} = 0.10$, SD = 0.02). Because there was not meaningful variance in the change in density across time, teams increased in friendship network density at approximately the same small rate.

Table 8: Results of Bayesian Growth Models Examining Hypotheses 8 and 9 Regarding Team Friendship Network Density over Time^{abc}

	A. Base Model				B. Prediction Model			
	Mean	SD	2.5%	97.5%	Mean	SD	2.5%	97.5%
Initial friendship density	2.98	0.06	2.85	3.10	2.98	0.06	2.87	3.09
Time	0.10	0.02	0.05	0.14	0.10	0.02	0.06	0.14
Team trait positive affect					0.55	0.22	0.09	-0.99
σ^2 , intercept	0.30	0.04	0.22	0.39	0.27	0.04	0.20	0.36
σ^2 , residual	0.20	0.02	0.16	0.23	0.19	0.02	0.16	0.23
R_y^2	0.70				0.70			
$R_{intercept}^2$					-0.18			
Deviance	-44.41				-45.47			
DIC	-13.29				-15.33			

^a Team-level N = 33 × 3 time points.

^b Team friendship network density across time is the criterion.

^c Values are posterior means, standard deviations, and 95% credibility intervals.

I predicted in Hypothesis 8 that, by shaping how positive people perceive others (i.e., the rosy glasses effect) and how positive people are perceived by others (i.e., the halo effect), team trait positive affect would be positively related to friendship network density during early development. As can be seen in the Prediction Model of Table 8, the data provided strong support for this hypothesis; team trait positive affect was strongly, positively related to initial team friendship network density (Posterior $\bar{X} = 0.55$, $SD = 0.22$). Teams higher in team trait positive affect had, immediately during early development, denser friendship networks than did teams lower in team trait positive affect.

In Hypothesis 9 I predicted that, over time, team trait positive affect and team friendship network density would reciprocally interact so that teams high in team trait positive affect would develop networks of increasing density over time. Drawing from theory on interpersonal relationships and affect, which suggests that intrateam relationships both transmit and are sources of positive affect, I proposed that teams high in positive affect slip into a virtuous cycle of positive experiences and that members of such teams continue to have positively biased interpersonal perception over time. As detailed above in the results of analyses used to determine the base growth model for friendship density, however, there was not meaningful variation in the change slope of team friendship network density. Because teams did not vary in the rate at which they increased friendship network density over time, I could not test for the relationship between team trait positive affect and friendship network density. And, indeed, due to the lack of meaningful variance in friendship network density change over time, Hypothesis 9 was not supported by the data.

In sum, my hypotheses regarding the relationship between team trait positive affect and the development of team friendship network density over time were partially supported by the data. While teams higher in team trait positive affect did have denser friendship networks in the earliest days of team life, there was minimal and insignificant variance in change in friendship network density over time; across development project teams in-

creased in friendship density essentially in parallel.

Team Trait Positive Affect and the Development of Team Efficacy over Time

Figure 2, Plot E depicts individual project team trajectories and the average trajectory of the development of team efficacy over time. On average, teams increased in efficacy from early development through late development. However, based on the plot, there appeared to be substantial variance across teams both in initial team efficacy and in how teams changed in efficacy across time. Table 4E provides the results of a series of Bayesian growth models used to determine the most appropriate base growth model for team efficacy. The relationship between time and team efficacy was linear, rather than quadratic (i.e., Model 1, rather than Model 2); a fixed quadratic effect was not meaningfully different from zero. Allowing the change intercept to vary across teams (i.e., Model 3), yielded a substantial improvement in model fit (Δ deviance = -152.4), indicating that teams differed at the start of team development in the extent to which they believed they would perform effectively. Finally, as shown in Model 4 of Table 4D, there was also significant variance across teams in how they changed over time in team efficacy (Δ deviance = -36.3). Based on these results, I thus selected as a base growth model one with a linear trend, a varying change intercept, and a varying change slope.

Table 9: Results of Bayesian Growth Models Examining Hypotheses 10 and 11 Regarding Team Efficacy over Time^{abc}

	A. Base Model				B. Prediction Model			
	Mean	SD	2.5%	97.5%	Mean	SD	2.5%	97.5%
Initial team efficacy	3.71	0.13	3.45	3.98	3.71	0.13	3.46	3.96
Time, linear	0.12	0.05	0.02	0.22	0.12	0.05	0.02	0.22
Team trait positive affect					1.42	0.54	0.39	2.56
Time $\times$ Team trait positive affect					-0.17	0.21	-0.59	0.22
σ^2 , intercept	0.74	0.11	0.56	0.99	0.67	0.11	0.48	0.90
σ^2 , slope	0.18	0.07	0.04	0.31	0.18	0.08	0.01	0.32
$r_{intercept,slope}$	-0.34	0.29	-0.87	0.30	-0.28	0.33	-0.85	0.65
σ^2 , residual	0.29	0.04	0.23	0.38	0.29	0.04	0.22	0.38
R_y^2	0.84				0.84			
$R_{intercept}^2$					0.20			
R_{slope}^2					0.04			
Deviance	34.21				34.87			
DIC	80.58				81.37			

^a Team-level N = 33 $\times$ 3 time points.

^b Team efficacy across time is the criterion.

^c Values are posterior means, standard deviations, and 95% credibility intervals.

The Base Model in Table 9 presents the detailed results of this selected model. On average, teams began during early development with moderately high team efficacy (Posterior $\bar{X} = 3.71$, $SD = 0.13$), though the variance in this initial team efficacy was substantial (Posterior $\bar{X} = 0.74$, $SD = 0.11$). Teams increased in efficacy, on average, across time (Posterior $\bar{X} = 0.12$, $SD = 0.05$), though again there was significant variance across teams such that some teams had a more positive slope than others (Posterior $\bar{X} = 0.18$, $SD = 0.07$). While the spread was large around the Posterior Mean for the correlation between the team efficacy change intercept and the change slope (Posterior $\bar{X} = -0.34$, $SD = 0.29$), the credibility interval leaned more towards a negative relationship than a positive one, suggesting a weak tendency for teams that started high in team efficacy to have less positive growth in team efficacy over time.

In Hypotheses 10 and 11 I predicted that team trait positive affect shapes how a team develops team efficacy over time. The Prediction Model in Table 9 presents the results of a Bayesian growth model used to examine the relationship between team trait positive affect and, respectively, the change intercept and change slope for team efficacy. Drawing from theory and research on interpersonal perception and individual optimism, I predicted first in Hypothesis 10 that team trait positive affect is positively related to initial team efficacy during the information-scarce time of the early development phase. As Table 9 shows, the data provided substantial support for this hypothesis; team trait positive affect was strongly and positively related to initial team efficacy (Posterior $\bar{X} = 1.42$, $SD = 0.54$). Indeed, the credibility interval indicated that there is a 95% probability that a one-point increase in team trait positive affect (on a 5-point scale), yields an increase in team efficacy of between 0.39 and 2.56 points (on a 5-point scale).

Extending Gibson's (2003) information-processing conceptualization, grounded in theory and research on mood congruent memory and goal regulation, I predicted in Hypothesis 11 that team trait positive affect is positively related to growth in team efficacy over time.

Remembering their successes more than their failures, and feeling positively by performing effectively in small performance episodes, teams high in positive affect, I suggested, fall into a virtuous cycle of growth in team efficacy over time. To investigate this hypothesis I examined the interaction between time and team trait positive affect in predicting team efficacy. This interaction term represents how team trait positive affect moderates the relationship between time and team efficacy. Said differently, the interaction represents the how the change slope of team efficacy varies according to team trait positive affect. As seen in the Prediction Model of 9, the data did not support Hypothesis 11. With a credibility interval centered slightly left of zero, the data provided no evidence that team trait positive affect is positively related to the change slope of team efficacy (Posterior $\bar{X} = -0.17$, SD = 0.21).

To summarize, my hypotheses regarding the growth of team efficacy over time were thus partly supported. Project teams high in team trait positive affect did begin their development with higher team efficacy than did teams low in team trait positive affect. Yet, while there was significant variance in team efficacy change over time, team trait positive affect was not significantly related to this change.

Team Trait Positive Affect, Team Development, and Team Effectiveness

In addition to my hypotheses regarding the relationship between team trait positive affect and team development, I proposed in my theory of positive affect and team development and effectiveness that developmental trajectories—patterns of team resource development across time—are related to project team effectiveness at the project deadline. And, furthermore, I proposed that team trait positive affect has a positive relationship with team effectiveness at the project deadline *indirectly* through its impact on the development of (a)

team task routines; (b) team friendship network density; and, (c) team efficacy. I tested my predictions about team development and team effectiveness both individually and simultaneously using a series of Bayesian path models and the estimates of team developmental trajectories from the Bayesian growth models reported above. That is, for each developmental trajectory, I extracted the Bayesian estimators of the change intercept and, where applicable, the change slope for each of the project teams in my sample.

Table 10: Means, Standard Deviations, and Intercorrelations of Growth Trajectory Parameters and Selected Study Variables^{abcd}

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6
1. Team ability	0	0.26	—					
2. Team experience	0	0.24	0.13	—				
3. Team formation activity	0	0.34	−0.21	0.15	—			
4. Team trait positive affect	0	0.23	0.24	0.11	0.13	—		
5. Initial exploratory search	0	0.35	−0.23	0.10	0.01	0.09	—	
6. Exploratory search change	0	0.2	−0.15	−0.21	0.22	−0.37	−0.36	—
7. Initial exploitative refining	0	0.32	0.30	0.32	−0.06	0.42	0.21	−0.70
8. Exploitative refining change	0	0.13	−0.28	−0.32	0.18	−0.23	−0.18	0.61
9. Initial friendship density	0	0.25	0.08	0.21	0.07	0.42	0.20	−0.07
10. Initial team efficacy	0	0.67	0.36	0.42	−0.06	0.44	0.47	−0.57
11. Team efficacy change	0	0.12	−0.29	−0.13	0.25	−0.16	−0.11	0.19
12. Team effectiveness	6.42	0.11	0.22	0.47	−0.07	0.56	0.26	−0.32

^a Team-level N = 33.

^b Where N = 33, for correlations $|.34|, p < .05$; $|.44|, p < .01$., two-tailed.

^c Values for initial and change entries are means of the posterior distributions from Bayesian growth models.

^d All variables except team effectiveness are mean-centered.

^e Team effectiveness has been log-transformed.

Table 10: Means, Standard Deviations, and Intercorrelations of Growth Trajectory Parameters and Selected Study Variables^{abcd} (continued)

	7	8	9	10	11	12
1. Team ability						
2. Team experience						
3. Team formation activity						
4. Team trait positive affect						
5. Initial exploratory search						
6. Exploratory search change						
7. Initial exploitative refining	—					
8. Exploitative refining change	−0.75	—				
9. Initial friendship density	0.01	0.05	—			
10. Initial team efficacy	0.54	−0.50	0.41	—		
11. Team efficacy change	−0.03	0.34	−0.30	−0.32	—	
12. Team effectiveness	0.37	−0.31	0.48	0.57	−0.22	—

^a Team-level N = 33.

^b Where N = 33, for correlations $|.34|, p < .05$; $|.44|, p < .01$., two-tailed.

^c Values for initial and change entries are means of the posterior distributions from Bayesian growth models.

^d All variables except team effectiveness are mean-centered.

^e Team effectiveness has been log-transformed.

Table 10 provides means, standard deviations, and intercorrelations among the components of the team development trajectories (i.e., change intercepts and change slopes) and selected study variables. A number of zero-order correlations between growth trajectory parameters and team effectiveness were consistent with my hypotheses. As expected, the change slope for exploratory search was negatively related to team effectiveness ($r = -0.32, p < .10$), indicating that teams that decreased their focus on learning behavior over time outperformed those that did not. Although not a relationship that I predicted, initial exploitative refining was positively related to team effectiveness ($r = 0.37, p < .05$). Additionally, the change intercepts for team friendship network density ($r = 0.48, p < .01$) and team efficacy ($r = 0.57, p < .01$) were, respectively, positively related to team effectiveness. There were also a number of interesting and significant correlations among the growth trajectory components. Teams with dense friendship networks during the early development phase (i.e., a high change intercept for friendship network density) decreased their focus on learning over time ($r = -0.57, p < .01$) and had higher team efficacy during early development ($r = 0.41, p < .05$). Teams with high efficacy in early development, in turn, tended to have a higher focus on exploratory search during early development ($r = 0.47, p < .01$).

Surprisingly, while team experience was significantly related to team effectiveness ($r = 0.47, p < .01$), the other two variables that I measured and intended to use as controls in analyses predicting team effectiveness—team ability and team formation activity—did not have sizable or significant zero-order relationships with team effectiveness. Indeed, the zero order correlation between team formation activity and team effectiveness was approximately zero ($r = -0.07, ns$) and the correlation between team ability and team effectiveness was relatively small and not significant ($r = 0.22, ns$). In the results reported below, I present path models without team formation activity and team ability because including these control variables (a) did not meaningfully change the estimates of other param-

ters; (b) did not meaningfully improve prediction of team effectiveness; (c) did not change substantive interpretations; and, (d) required estimating additional parameters in a set of already parameter-heavy models. As such, in predicting team effectiveness, I controlled only for the combined prior experience of team members in the military competition.

Team Trait Positive Affect, Task Routine Development, and Team Effectiveness

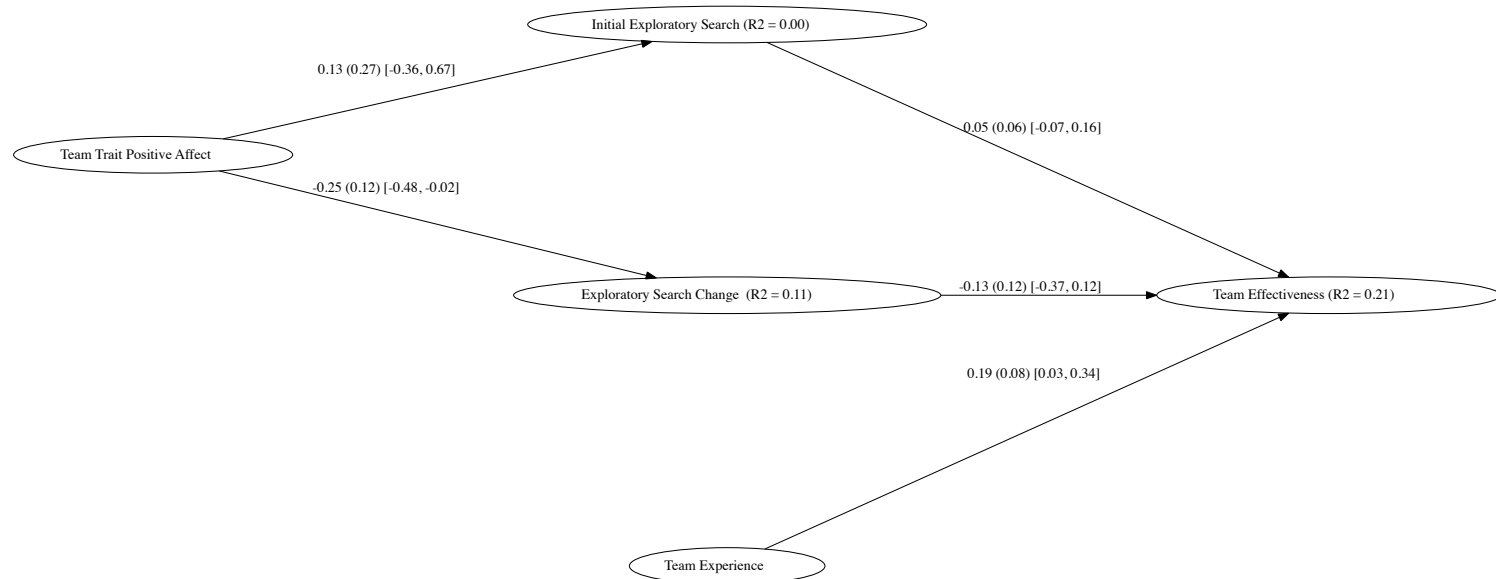
I predicted in Hypotheses 12 through 15 that team trait positive affect indirectly affects team performance through initial exploratory search and the pattern of, respectively, exploratory search and exploitative refining over time. Figure 4 presents the results of a Bayesian path model of my initial conceptualization of the relationship between team trait positive affect, the trajectory of exploratory search over time, and team effectiveness. Consistent with analyses reported above, there was a meaningful negative relationship between team trait positive affect and exploratory search change such that teams higher in team trait positive affect decreased their focus on exploratory search over time (Posterior $\bar{X} = -0.25$, $SD = 0.12$), while the relationship between team trait positive affect and initial exploratory search was not significant (Posterior $\bar{X} = 0.13$, $SD = 0.27$).

In Hypothesis 12 I predicted that initial exploratory search is positively related to team effectiveness. Although in the predicted direction, the relationship between initial exploratory search and team effectiveness was not significant (Posterior $\bar{X} = 0.05$, $SD = 0.06$). Hypothesis 12 was thus not supported by the data. I predicted in Hypothesis 13 that the change slope of exploratory search is negatively related to team effectiveness. Consistent with this hypothesis, change in exploratory search over time was associated with a decrease in team effectiveness (Posterior $\bar{X} = -0.13$, $SD = 0.12$), though the posterior standard deviation was somewhat large relative to the effect. Still, the data lend some sup-

port to the prediction that teams that decreased their focus on exploratory search over time outperformed those that did not. Including the control variable team experience, which was positively related to team effectiveness (Posterior $\bar{X} = 0.19$, $SD = 0.08$), the model explained 21% of the variance in project team effectiveness.

In Hypothesis 14 I predicted that growth in exploitative refining over the course of project team life is positively related to team effectiveness. Figure 5 presents the results of a Bayesian path model relating team trait positive affect to team effectiveness through the growth trajectory of exploitative refining. Contrary to Hypothesis 14, the relationship between exploitative refining change over time and team effectiveness was not significant (Posterior $\bar{X} = -0.01$, $SD = 0.22$). Including the control variable team experience, the model explained 19% of the variance in team effectiveness.

Figure 4: Bayesian Path Model Examining Hypotheses 12, 13, and 15 Regarding Team Trait Positive Affect, Exploratory Search Trajectory, and Team Effectiveness^{abc}

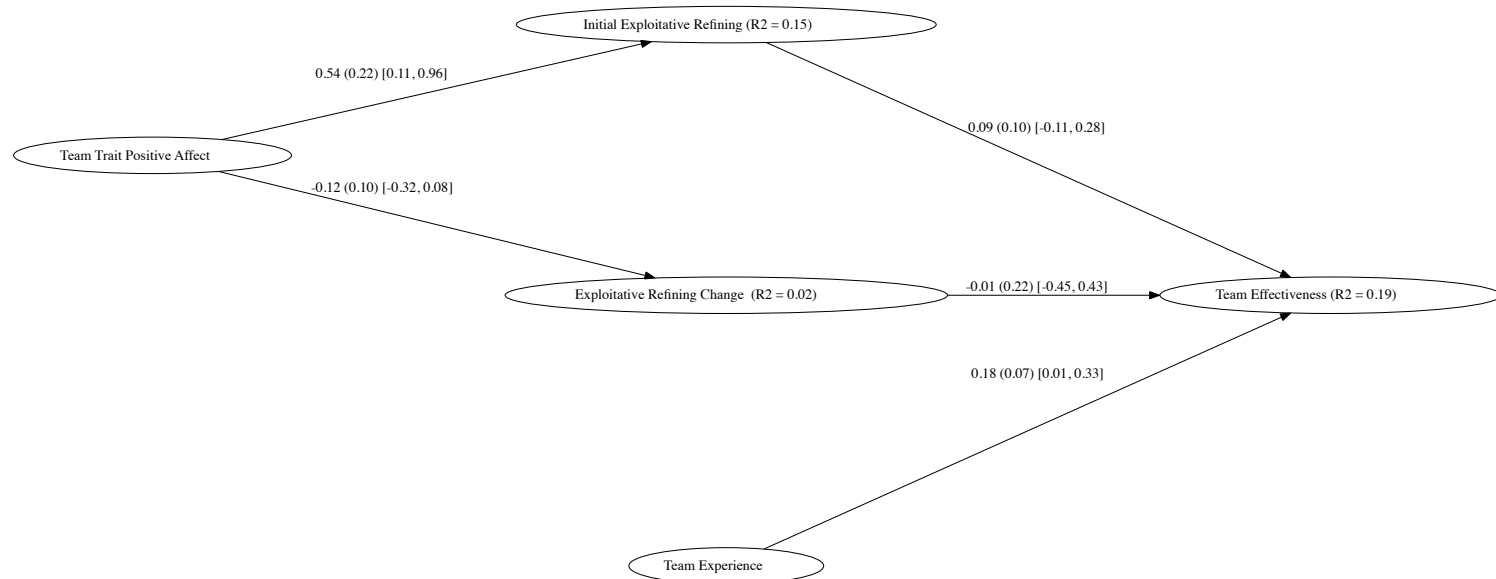


^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -63.2; DIC = -52.6

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Figure 5: Bayesian Path Model Examining Hypotheses 14 and 15 Regarding Team Trait Positive Affect, Exploitative Refining Trajectory, and Team Effectiveness^{abc}

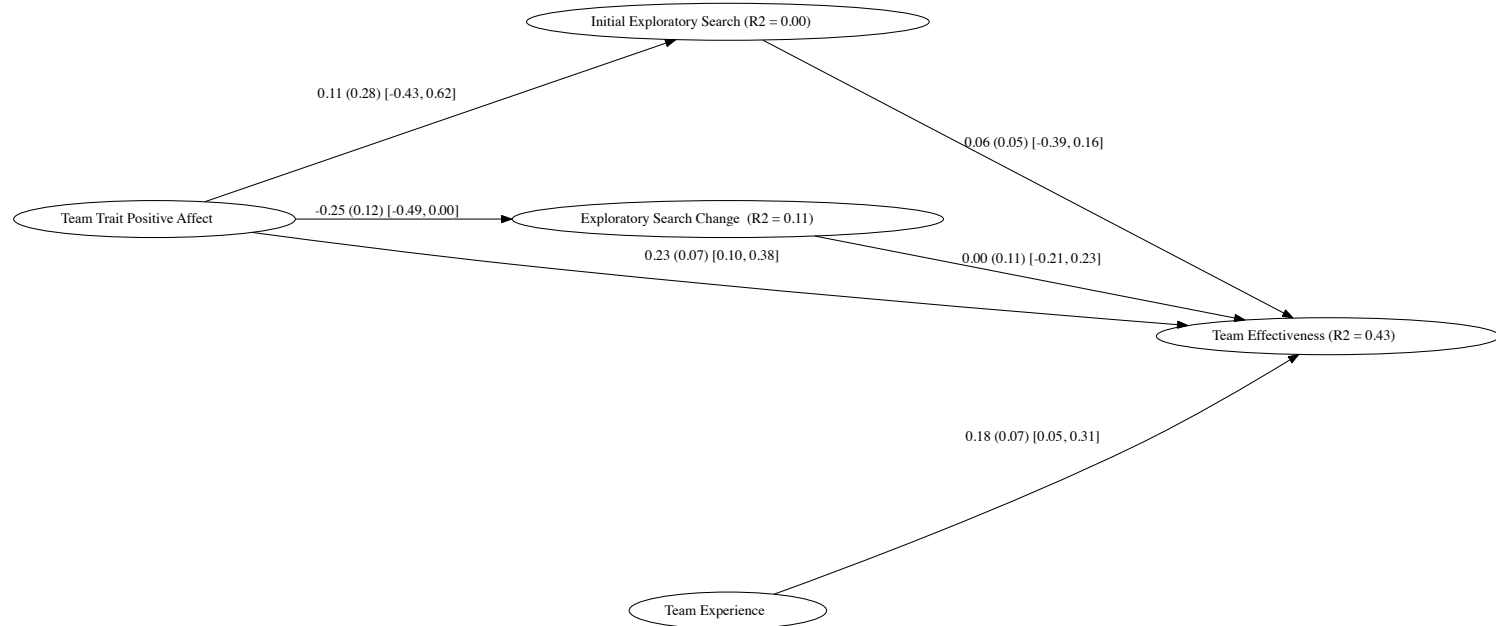


^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -86.6; DIC = -72.6

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Figure 6: Revised Bayesian Path Model Examining Hypotheses 12, 13, and 15 Regarding Team Trait Positive Affect, Exploratory Search Trajectory, and Team Effectiveness^{abc}

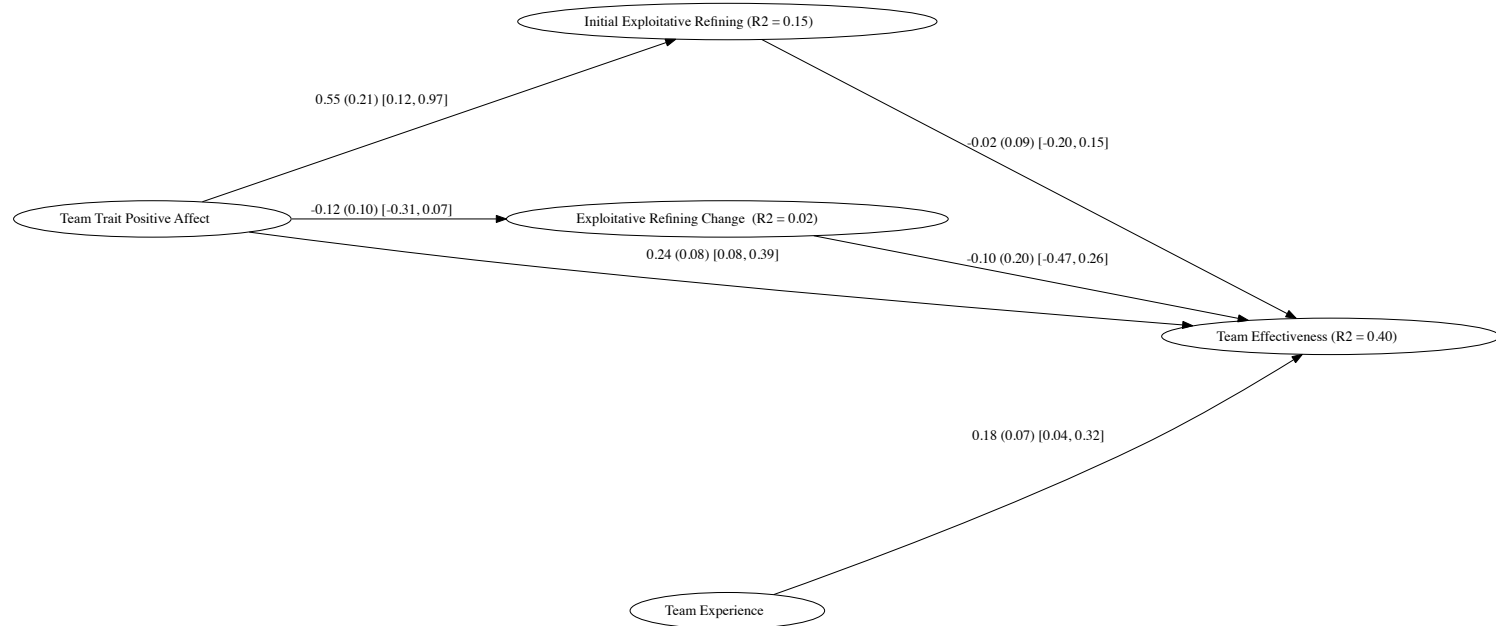


^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -72.4; DIC = -59.6

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Figure 7: Revised Bayesian Path Model Examining Hypotheses 14 through 15 Regarding Team Trait Positive Affect, Exploitative Refining Trajectory, and Team Effectiveness^{abc}



^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -96.7; DIC = -80.6

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

In Hypothesis 15, I proposed that the effect of team trait positive affect on team effectiveness is indirect, operating through its effects on the development of team task routines over time. To examine the nature of the relationship between team trait positive affect and team effectiveness, I fit complementary path models for exploratory search and exploitative refinement that incorporated a direct path from team trait positive affect to team effectiveness. These models, presented as, respectively, Figure 6 and Figure 7, both fit the data better models without the direct path. In the model for exploratory search (Figure 6), the relationship between team trait positive affect and team effectiveness was significant and large (Posterior $\bar{X} = 0.23$, $SD = 0.07$). And, the relationship between the exploratory search change slope and team effectiveness dropped to zero (Posterior $\bar{X} = 0.00$, $SD = 0.11$), while the variance explained in project team effectiveness increased to 43%. Similarly, the direct relationship between team trait positive affect and team effectiveness in the model for exploitative refinement was significant and sizable (Posterior $\bar{X} = 0.43$, $SD = 0.08$). Thus, Hypothesis 15, which predicted that team trait positive affect is indirectly related to project team performance through its impact on task routine development, was not supported by the data. Rather, the data indicated that team trait positive affect has a direct, positive, and large effect on project team effectiveness; because I log-transformed team score in the military competition, my findings indicate that a one-point increase in team trait positive affect is associated with approximately a 23% increase in team effectiveness.

Team Trait Positive Affect, Friendship Network Density Development, and Team Effectiveness

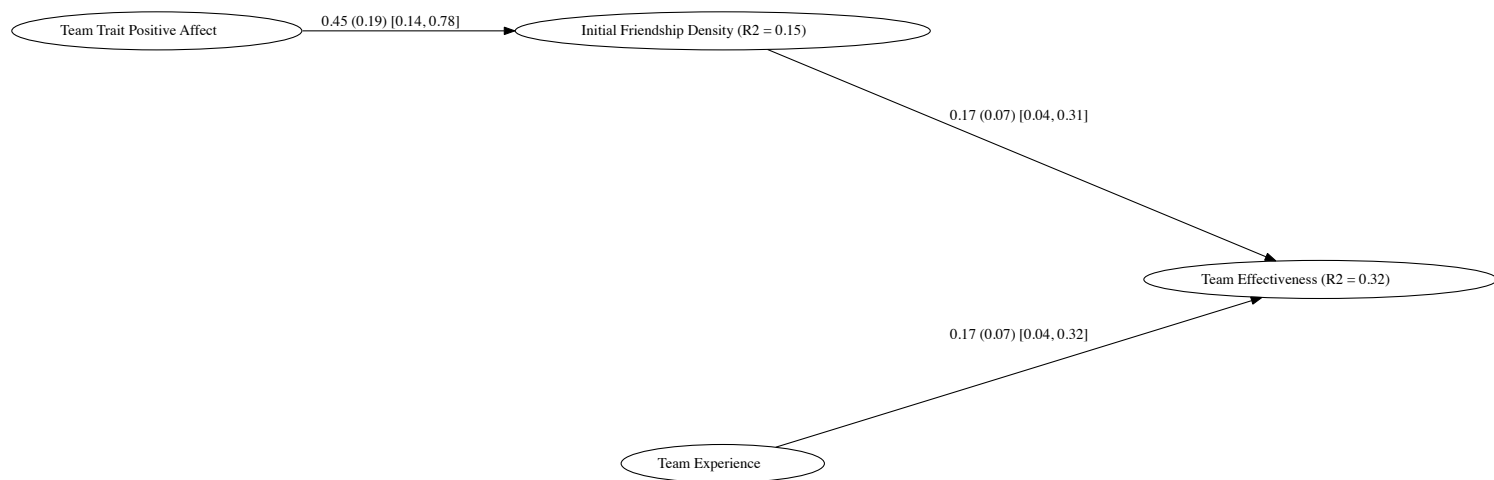
In Hypotheses 16 through 18 I predicted that team trait positive affect also has an indirect effect on project team effectiveness through the growth trajectory of team friendship network density. As reported above, however, I found significant variance across teams only

in the change intercept for friendship network density; project teams had approximately the same change slope. Thus, in testing my predictions regarding the indirect effects of team trait positive affect through friendship network density, I constructed a Bayesian path model including only the change intercept for the growth trajectory of friendship network density. Figure 8 presents the results of this Bayesian path model for my initial conceptualization. Consistent with results reported above, team trait positive affect had a strong, positive relationship with initial team friendship network density (Posterior $\bar{X} = 0.45$, $SD = 0.19$), explaining approximately 15% of the variance in the change intercept. And, as I predicted in Hypothesis 16, initial friendship network density was positively related to project team effectiveness (Posterior $\bar{X} = 0.17$, $SD = 0.07$). In total, the model explained 32% of the variance in project team effectiveness and a one point increase in initial friendship network density was associated with approximately a 17% increase in team performance in the military competition.

I predicted in Hypothesis 18 that the relationship between team trait positive affect and project team effectiveness is indirect, operating through a relationship with the friendship network density growth trajectory. To test for a purely indirect effect, I fit a model including a direct effect of team trait positive affect on project team effectiveness. The results of this model, presented as Figure 9, show that the addition of the direct effect improved the fit of the model (Δ deviance = -7.4) and the path from team trait positive affect directly to project team effectiveness was significant (Posterior $\bar{X} = 0.20$, $SD = 0.07$). Unexpectedly, including the direct effect in the model reduced the magnitude of the path from initial friendship network density to project team effectiveness (Posterior $\bar{X} = 0.09$, $SD = 0.07$). Thus, while I did find an indirect effect of team trait positive affect on project team effectiveness through initial friendship network density, team trait positive affect also had a powerful direct relationship with project team effectiveness, lending mixed support for Hypothesis 18. The model with a direct path from team trait positive affect to project team

effectiveness explained approximately 46% of the variance in project team effectiveness.

Figure 8: Bayesian Path Model Examining Hypotheses 16 through 18 Regarding Team Trait Positive Affect, Team Friendship Network Density Development, and Team Effectiveness^{abc}

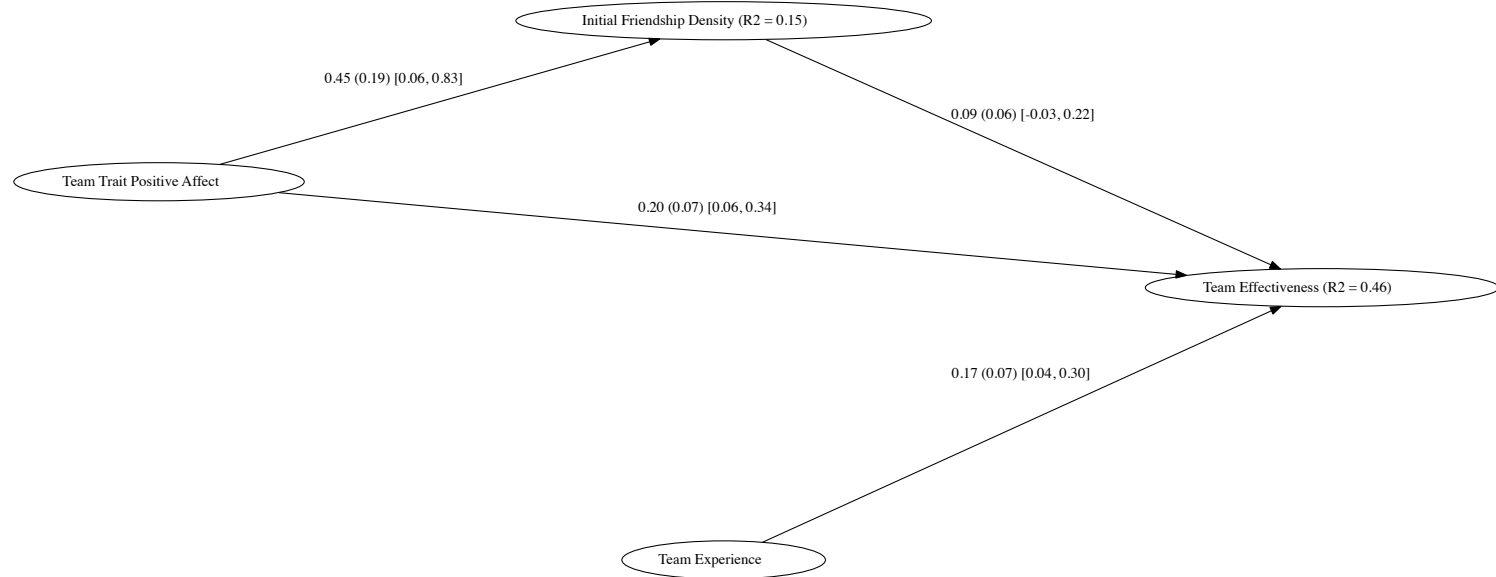


^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -62.0; DIC = -55.1

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Figure 9: Revised Bayesian Path Model Examining Hypotheses 16 through 18 Regarding Team Trait Positive Affect, Team Friendship Network Density Development, and Team Effectiveness^{abc}

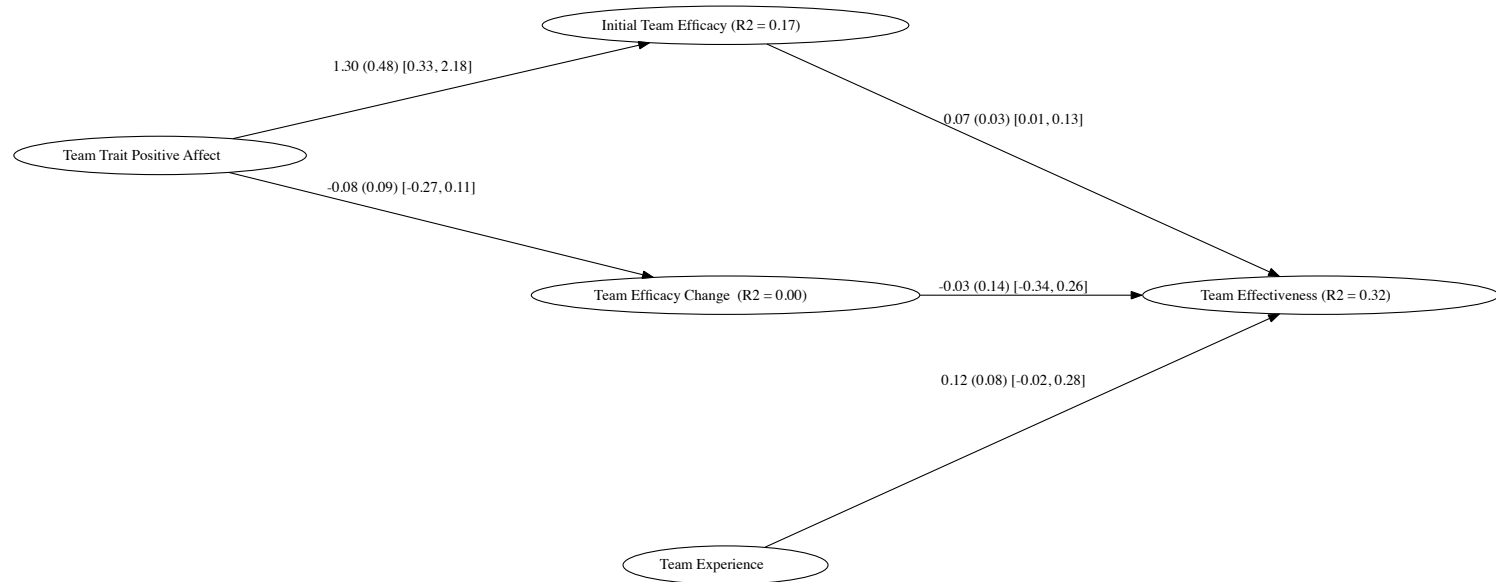


^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -69.4; DIC = -61.6

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Figure 10: Bayesian Path Model Examining Hypotheses 19 through 21 Regarding Team Trait Positive Affect, Team Efficacy Development, and Team Effectiveness^{abc}

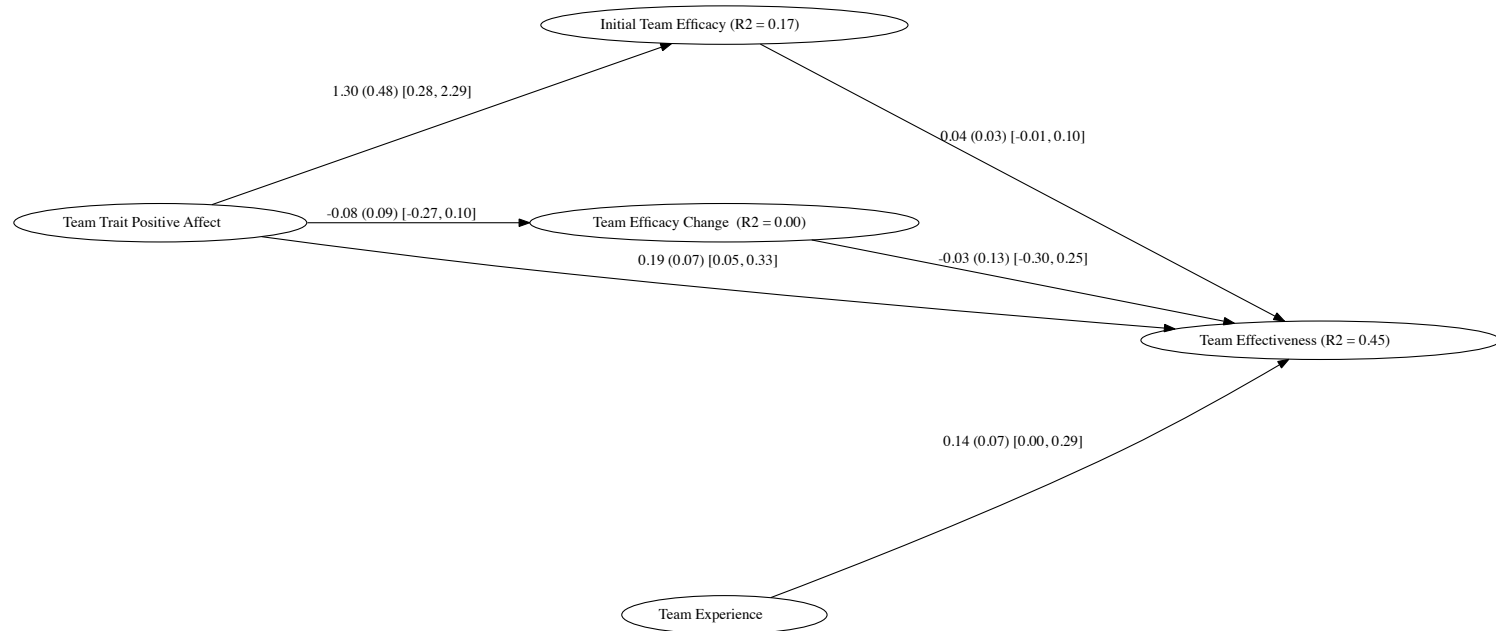


^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -43.6; DIC = -33.3

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Figure 11: Revised Bayesian Path Model Examining Hypotheses 19 through 21 Regarding Team Trait Positive Affect, Team Efficacy Development, and Team Effectiveness^{abc}



^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -50.3; DIC = -38.9

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Team Trait Positive Affect, Team Efficacy, and Effectiveness

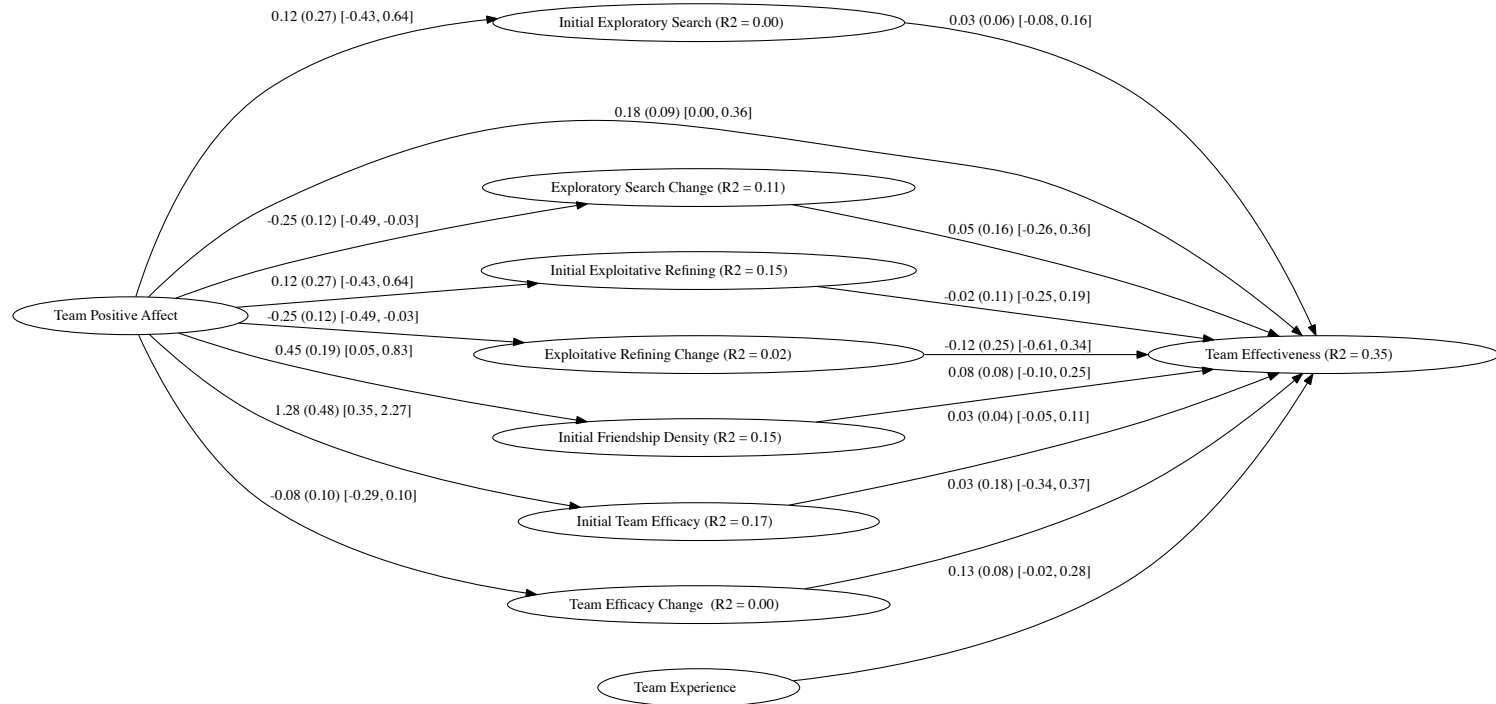
In Hypotheses 19 through 21 I predicted that team trait positive affect has an indirect relationship with team effectiveness through the growth trajectory of team efficacy. Figures 10 and 11 present the results of two Bayesian path models used to test these hypotheses. Consistent with findings reported above, I found a large, positive relationship between team trait positive affect and initial team efficacy (Posterior $\bar{X} = 1.30$, $SD = 0.48$), but a non-significant relationship between team trait positive affect and the change slope of team efficacy (Posterior $\bar{X} = -0.08$, $SD = 0.09$). Team trait positive affect explained approximately 17% of the variance in initial team efficacy. Consistent with Hypothesis 19, initial team efficacy was positively related to team effectiveness (Posterior $\bar{X} = 0.07$, $SD = 0.03$); a one point increase in initial team efficacy was associated with a 7% increase in team competition score. Hypothesis 20, in which stated that the change slope of team efficacy is positively related to team effectiveness, was not supported (Posterior $\bar{X} = -0.03$, $SD = 0.14$). In total, the model explained 32% of the variance in project team effectiveness.

To further examine Hypothesis 21, in which I predicted that team trait positive affect has an indirect relationship with project team effectiveness, I constructed a model with a direct path from team trait positive affect to project team effectiveness. As seen in Figure 11, this model fit the data better than my original conceptualization (Δ deviance = -6.7) and team trait positive affect had a positive, direct relationship with project team effectiveness (Posterior $\bar{X} = 0.19$, $SD = 0.07$). The size of the estimated relationship between initial team efficacy and project team effectiveness, contrary to my predictions, shrank in magnitude relative to the original model (Posterior $\bar{X} = 0.04$, $SD = 0.03$), indicating that team trait positive affect has a direct relationship with project team effectiveness above and beyond its relationship through initial team efficacy. Hypothesis 21 thus received mixed support. The revised model, including a direct path from team trait positive affect to project team effectiveness, explained 45% of the variance in team effectiveness.

Simultaneous Model

Each of the revised individual models described above showed a significant direct relationship between team trait positive affect and project team effectiveness, above and beyond the indirect relationship through the individual growth trajectory components. Intuitively and statistically, this is to be expected; an individual test of, for example, the friendship network density trajectory leaves out the indirect effect of team trait positive affect through the team efficacy growth trajectory and the task routine development trajectories. To examine my full conceptual model, I constructed a Bayesian path model relating team trait positive affect to project team effectiveness indirectly and simultaneously through all growth trajectory parameters. With the large number of parameters to estimate in a single model relative to the size of the team-level sample, however, the results of this model must be interpreted with caution.

Figure 12: Bayesian Path Model Examining Hypotheses 12 through 21 regarding Team Trait Positive Affect, Team Development, and Team Effectiveness^{abc}



^aValues are: Posterior Mean (Posterior Standard Deviation) [2.5%, 97.5%]

^bModel fit: Deviance = -81.9; DIC = -50.6

^cAdditional control variables for team effectiveness, not reported in the figure, are team ability and team formation activity.

Figure 12 presents the results of this path model, incorporating a direct path from team trait positive affect to project team effectiveness. While the relationships between team trait positive affect and the growth trajectory components were consistent with prior individual analyses, the relationships between the growth trajectory components and project team effectiveness were smaller and not significant. The direct relationship between team trait positive affect and project team effectiveness, however, remained strong, positive, and significant (Posterior $\bar{X} = 0.18$, $SD = 0.08$); a one point increase in team trait positive affect yielded an 18% increase in project team competition score. In total, the full model explained 35% of the variance in project team effectiveness. While, again, the results of this model must be interpreted with caution given the large number of parameters, the small relationships between the growth trajectory components and project team effectiveness—and the large direct relationship between team trait positive affect and project team effectiveness—are inconsistent with my conceptual model presented as Figure 1. I consider in detail the surprising durable and strong direct relationship between team trait positive affect and team effectiveness in my discussion.

In sum, regarding the predicted relationships between team trait positive affect, team developmental trajectories, and team effectiveness, the data suggest that team trait positive affect has a direct impact on project team effectiveness, above and beyond indirect effects through team development. Additionally, the data suggest that the relationship between individual growth trajectory parameters and project team effectiveness tend to be small and are often insignificant once the direct relationship between team trait positive affect and team effectiveness is taken into account.

Discussion

I developed and tested a theoretical model of positive affect and project team development and effectiveness to begin to fill the gaps in the teams literature regarding how shared positive affective experiences influence team dynamics over time. In my theory, I proposed that team trait positive affect—a team’s stable tendency to have positive affective experiences over time—plays a central role in driving how a project team develops critical team resources—task routines, team friendship network density, and team efficacy—by broadening team members’ approaches to their tasks, their collective potential and, indeed, to one another. Over time and across phases of development, I suggested, the momentary benefits of broadened perspectives compound into stable stocks of team resources. Furthermore, I posited that the paths that a team travels over time in developing these resources—or, its developmental trajectories—influence project team effectiveness. The results of my study of 33 project teams confirm portions of my model, suggest extensions and modifications to my model, and have important implications for team development theory and research.

Summary of Key Findings

In project teams, team trait positive affect forms, in part my findings indicate, through similarity-attraction mechanisms that draw together team leaders and prospective team members who are similar in individual trait positive affect. With a central, visible, and

influential node (i.e., the team leader) pulling into the team others who are affectively similar to him/her, a project team begins its life during team formation with a certain, characteristic level of team trait positive affect. Project teams are thus relatively homogeneous in team members' individual trait positive affect, leading the team to exhibit a meaningful collective affect at the team-level. Team trait positive affect, my results suggest, shapes the positivity of affective experiences that team members share over time (i.e., team positive mood). Like individual trait positive affect, and in line with other theory and research on positive affect at the team level (e.g., George, 1990, 1996; Kelly & Barsade, 2001), my theory and findings suggest that team trait positive affect is a durable and stable team-level characteristic that influences the types of affective experiences that a team has over time.

In line with key components of my conceptual model, my empirical findings indicate that team trait positive affect influences team developmental trajectories. With respect to the development of team task routines, I proposed and found that team trait positive affect is associated with a team's pattern of exploratory search over time such that teams high in team trait positive affect shut down their focus on exploration after the temporal midpoint of project team life, while teams low in team trait positive affect persisted in searching for the best approach for completing their tasks. My findings suggest that team trait positive affect is one team characteristic that helps project teams to navigate the midpoint transition of team development and, as I discuss further below, break out of exploratory types of team learning behavior and migrate their focus to implementing and refining discovered solutions and selected routine components. This pattern of change in exploratory search over time recalls the classic distinction between exploration and exploitation (March, 1991) and the challenges that groups, teams, and indeed organizations often face in balancing a need to discover new, innovative solutions for their activities and a need to routinize, master, and reap the benefits of identified solutions. In project teams, my theory and my findings suggest, team trait positive affect aids in an effective transition from one type of

activity to the other. Unexpectedly, however, my findings also suggest that the two types of activities—exploratory search and exploitative refinement—are not mutually exclusive. Rather, project teams engaged exploitative refinement even in early development, while simultaneously engaging in exploratory search.

I also proposed and found that team trait positive affect is positively associated with initial levels of friendship network density during the early development phase; teams high in team trait positive affect exhibited more densely connected friendship networks than did teams low in team trait positive affect. Unexpectedly, while they did vary in their initial levels of friendship density, the project teams in my sample did not vary meaningfully in their rates of change in friendship density over time. It is possible that the lack of variance in the friendship network density change slope was a function of the structure of the project teams that composed my sample and the nature of my research setting. Specifically, and as I address in more detail below, the military competition teams that I studied were composed of hierarchically-divided members such that each team had representatives from each class at West Point. The class structure at West Point is, indeed, akin to a military rank structure; a Plebe (i.e., a freshman) is lower rank than a Cow (i.e., a junior). It is possible that this enforced structure restricted the range of variance in friendship network density change over time.

With respect to the development of team efficacy, I proposed and found that team trait positive affect is positively associated with initial team efficacy during the earliest days of project team life. The relationship between team trait positive affect and initial team efficacy was particularly strong; a one unit increase in team trait positive affect (i.e., on a 5-point scale) was associated with a 1.28 point increase in team efficacy (i.e., on a 5-point scale) during the early development phase. Contrary to my conceptual model, however, although teams did vary significantly in their rates of change in team efficacy over time, team trait positive affect was not positively related to this change. It is possible that I did not

detect a relationship between team trait positive affect and change in team efficacy over time due to ceiling effects in my team efficacy measure. Specifically, a number of teams scored the maximum level on my team efficacy measure at the first measurement period and, as such, there was no room for these teams' measured team efficacy to increase over time even if they had increased in their latent team efficacy. While it is not possible to know for certain whether this indeed was the case in my data, the negative correlation between initial team efficacy and growth in team efficacy over time suggests that this is likely the case. Future research should revisit the relationship between team trait positive affect and team efficacy change over time using an expanded measurement scale or alternative methods that are buffered from ceiling effects.

Finally, I predicted in my theoretical model that team trait positive affect drives team effectiveness indirectly by shaping the development of team task routines, team friendship network density, and team efficacy over time. While I did find some evidence for indirect effects of team trait positive affect on team performance through the change slope of team learning behavior, the change intercept of team friendship network density, and the change intercept of team efficacy, my findings indicate that team trait positive affect also has a strong, positive, and direct relationship with team effectiveness. Indeed, even after accounting for team experience; team formation activity; team ability; and, the trajectory components (i.e., change intercept and change slope) for exploratory search, exploitative refinement, team friendship network density, and team efficacy, a one unit increase in team trait positive affect (i.e., on a 5-point scale) was associated with an 18% increase in a project team's performance score.

Implications for Team Development Theory and Research

My conceptualization of team trait positive affect and team development and effectiveness, together with the results of my empirical study suggest that theory and research on team development and effectiveness that ignore or fail to account for the role of affective constructs likely provide an incomplete picture of team dynamics. Although my empirical test is of just thirty-three project teams, the large magnitude and durability of the relationship between team trait positive affect and team effectiveness suggests that the effect is replicable. Furthermore, the relatively high average level of team trait positive affect and the relatively small range of variance in team trait positive affect in my sample ($\bar{X} = 3.81$, $SD = 0.25$ on a 5-point scale) together suggest that the relationship might be even larger with a different sample. My sample of West Point teams, most of which were relatively high in team trait positive affect, may not fully represent teams that are truly at the low end of the team trait positive affect spectrum and, as such, the population relationship between team trait positive affect and team effectiveness might be even larger than my sample data suggest. Future research should explore the relationship between team trait positive affect and project team effectiveness using a sample of teams that covers a wider range of team trait positive affect than covered by my sample.

For teams researchers studying other popular constructs in relation to team effectiveness, including team friendship network density, team cohesion, team potency, and team efficacy, my results prompt an interesting and provocative question: Are the significant effects heretofore observed and documented between these constructs and team effectiveness spurious and a byproduct of a powerful relationship between team trait positive affect and team effectiveness? Clearly one empirical study of 33 teams does not provide a definitive answer. Yet, my theory of positive affect and team development and effectiveness is grounded in the sizable literature on individual trait positive affect, which is littered

with homologous findings regarding an individual-level relationship between trait positive affect and individual performance across a variety of contexts, samples, and methodological approaches (e.g., Lyubomirsky et al., 2005; Staw & Barsade, 1993; Tsai et al., 2007). While individual-level research has demonstrated some of the mechanisms through which positive affect shapes performance, including social relationships and individual efficacy (Tsai et al., 2007), individual-level research suggests that, similar to my findings, there is a direct relationship between positive affect and performance. That the findings of my empirical study indicate that project teams high team trait positive affect are simply better project teams—above and beyond team experience, team ability, team formation activity, exploratory search, exploitative refinement, team friendship network density, and team efficacy—should spur future research on other channels through which team trait positive affect might impact team effectiveness and in-depth investigations into other mechanisms that might account for the strong direct effect observed in my study. In the course of such a program of research, future studies using new data and archival studies using existing data should revisit the accepted relationships between team efficacy and team friendship on the one hand, and team effectiveness on the other to explore how the estimated magnitude of these relationships might change if team trait positive affect is included as a covarying explanatory variable.

Not only does team trait positive affect have important static relationships with critical team constructs, such as team friendship network density and team efficacy, but my findings also suggest that team trait positive affect drives distinct patterns of change over time in a teams approach to developing critical task routines. Indeed, team trait positive affect, my results suggest, is a static team characteristic that accounts for dynamic team processes and emergent constructs. To date, the literature on team-level positive affect, and indeed even the literature on positive affect at the individual-level, has with few exceptions centered on relatively static relationships in cross-sectional studies (Lyubomirsky et al., 2005; Barsade

& Gibson, 2007). My findings indicate that an exciting area for future theory and research on team trait positive affect is not just how positive affect relates to other variables at a single point in time, but also how positive affect drives dynamic patterns of growth, change, and improvement across multiple points in time. With a long history and rich theoretical tradition of examining the relationship between affect and cognition at the individual-level, a key area for future team-level conceptual and empirical work is the intersection of team trait positive affect and the development of collective cognitive structures, such as team mental models or team transactive memory systems. My findings regarding especially the relationship between team trait positive affect and exploratory search over time suggest that team trait positive affect may have powerful effects on how such collective cognitive structures form, evolve, and crystallize over time.

My conceptual model and my findings also have implications for team learning theory and research. Empirical research on exploratory team learning behavior has to date been conducted primarily using long-standing groups and teams without a clear end point (e.g., Edmondson, 1999; Gibson & Vermeulen, 2003). The results of these studies of such teams suggest that exploratory search through team learning behaviors has positive consequences for team performance (Edmondson, 1999). My findings and my model, however, provide a more nuanced view of the benefits—and, importantly, of the costs—of exploratory search when considered in the context of an episodic model of project team development and effectiveness. As a team approaches the close of a performance episode, my model and my results suggest that exploratory search may actually detract from team performance. When teams have a fixed project deadline, they must serially balance the tension between exploration and, in a way, exploitation of interdependent team routines. Exploratory search in the later phases of team development, especially when the project deadline is near, means that time is taken away from repeated execution and practice of interdependent routines that, while discovered and selected, are still raw and unrefined. While my findings are

preliminary and should be replicated in other contexts using other methods, they suggest that time and *when* in the course of team life long jumps occur is a critical determinant of whether exploration is a benefit or a cost.

My findings reaffirm and extend theory and research on the prominent role of the temporal midpoint in project team development. Specifically, with respect to the development of team task routines over time, I posited and found in line with prior theory and research on project team development (e.g., Ericksen & Dyer, 2004; Gersick, 1988, 1989), that something special happens in project teams at their temporal midpoint. Extending prior theory and research on midpoint transitions, however, my conceptual model and associated findings provide a new answer to Gersick's (1988, p. 34) question "what factors affect the success of group transitions?" Team trait positive affect, my findings suggest, is one stable team characteristic that influences how a project team navigates the midpoint. And, furthermore, my findings point to satisficing and maximizing behavior as critical determinants of successful midpoint transitions. Gersick (1989) theorized that successful midpoint transitions are, in part, a function of project teams consciously redefining their situation, problem set, or task as a new situation requiring new methods and approaches. My theory and my findings, in contrast, suggest that successful midpoint transitions are driven by team members, under the pressure of their timeframe, accepting certain solutions and approaches as viable, although perhaps not the best. Rather than the midpoint serving as a signal of a new problem that requires a new and redefined problemistic search effort, as Gersick (1988) postulated, perhaps the midpoint serves instead as a signal for team members that spending time on exploratory search after the midpoint would create more problems than such search would solve. Indeed, my findings suggest that it is exploratory search—not exploitative refinement—that changes radically at the temporal midpoint. Future research on time and project team transitions should examine directly the role of maximizing and satisficing on changes in team strategies and exploratory search after the midpoint transition.

Implications for Practice

A clear takeaway from my theoretical model and from my empirical findings is that project teams composed of people high in trait positive affect have denser friendship networks, higher team efficacy, and very clearly outperform teams composed of people less high in trait positive affect. For a manager putting together a project team, the personnel selection and team composition implications of my findings are potentially very powerful. Indeed, theorists (e.g., Hackman, 1987) have long recognized the importance of team design for “setting the stage” for team success. In prior teams theory and research, however, the affective design of the team has received relatively little attention (Kozlowski & Ilgen, 2006) compared to the design of the team with respect to knowledge, skills, abilities, gender, ethnicity, and age. My findings, in line with the few other studies on affective composition of teams and team effectiveness (e.g., Barsade et al., 2000), suggest that managers seeking to design highly effective teams should select people who are predisposed to have positive affective experiences. Similarly, if a manager is choosing someone else—a team leader, perhaps—to assemble a project team, my findings suggest that the manager should choose someone who is high in individual trait positive affect. A team leader high in team trait positive affect is likely to attract and select others who are high in individual trait positive affect and yield a team that is high in team trait positive affect.

Yet, there are instances when managers may have little control over team composition. For example, perhaps a given task requires a specific expertise set held by a limited number of individuals. Or, perhaps because they are in high demand, individuals high in trait positive affect are already assigned to other projects. Beyond direct selection and team composition implications, my findings provide additional guidance for managers and team leaders seeking to optimize project team effectiveness. Although my findings and my model suggest that teams high in team trait positive affect tend to experience, on average, higher

levels of team positive mood over time, theory and research (e.g., Barsade, 2002; Kelly & Barsade, 2001) suggest that, beyond the impact of trait affect on positive mood, positive moods can be induced and spread throughout teams via contagion mechanisms. When unable to directly design teams high in team trait positive affect, mood contagion research suggests that leaders might instead try to induce and spread positive mood throughout their teams using their prominence and status as the one who often has the first and last word in team interactions; the team leader, in short, has the powerful ability to set the fleeting tone of momentary team interactions. Because, however, these induced moods are momentary, it might be difficult for a team not predisposed to experience positivity on a regular basis to sustain such moods over the course of team life. In these cases, my theory and my findings suggest team leaders might maximize the impact of positivity by localizing in time the induction of positive moods to yield the greatest benefit to the development of valuable team resources. Specifically, leaders in charge of teams less high in team trait positive affect might attempt to induce shared positive experiences during early team meetings and, especially my findings suggest, during meetings clustered at the temporal midpoint. The large body of research on mood induction at the individual level (e.g., Isen & Baron, 1991) and an emerging body of research at the team level (e.g., Barsade, 2002) offer a myriad of small, low-cost ways that a team leader might induce positive mood at these points in team development.

Limitations and Future Directions

As described above, an empirical study of West Point teams engaging in a structured military competition afforded a number of significant benefits in examining my theoretical model. The structure of the military competition enhanced the internal validity of tests of my theory. While variables such as task type, team size, and/or duration of project may

be of interest in future research, the structure of my research setting held these variables constant across teams, thereby ensuring that observed effects are not likely due to spurious relationships with these other variables. In the Sandhurst Competition, all teams follow the same rules, regulations, and official schedules; all teams carry out the same set of tasks; and, the performance of all teams is judged using the same set of criteria. Holding these variables constant across teams allowed me to focus my empirical test specifically on the variables in play in my theoretical model.

These benefits, however, potentially came at the cost of (a) generalizability and (b) low statistical power. With respect to generalizability, a military competition team made up of West Point cadets is without a doubt different on the surface in a number of ways from teams that operate in the business world. For example, West Point teams differ from many types of business teams in their demographic composition—teams are heavily male and predominantly white—and in their relatively rigid hierarchical structure—team members are structured according to their seniority. Additionally, the tasks completed by Sandhurst teams, in contrast to most business teams, are physical, military, and problem-solving tasks that are structured by defined rules. However, military teams, which have been the subject of extensive research in the organizational sciences (Dvir et al., 2002; Hofmann et al., 2003; Lim & Klein, 2006), are similar to project teams that operate in the business world in a number of significant ways relevant for my theory. First, military competition teams are project teams themselves—they have a clearly defined start date and a clearly defined end date, at which point their project deliverable is due. Second, military competition teams are goal-directed and engage in interdependent tasks that require communication, coordination, and leadership. And, third, failure to effectively function as a team and complete the project deliverable effectively carries significant consequences. Because of the structure of their project, however, the findings of my empirical test are most clearly and directly generalizable to project teams that have some degree of structure and a clearly defined and

immutable project deadline.

In addition to potentially limiting the generalizability of my empirical findings, the use of West Point project teams constrained the size of my team-level sample to 33 teams. While this team-level sample size is comparable, and actually exceeds, the sample size in other research recently published on team development (e.g., Mathieu & Rapp, 2009; Mathieu & Schulze, 2006), my small sample made comprehensive and simultaneous statistical tests of my relatively complex theoretical model inherently questionable. To somewhat mitigate these concerns I adopted a non-traditional analytical approach to examining my hypotheses—Bayesian growth modeling—that recent simulation-based studies indicate is superior to traditional maximum likelihood-based growth modeling. Furthermore, while my sample size reduced my power to detect effects in testing my theoretical model, making my empirical test a more conservative one, I still found a number of significant and interesting relationships among the variables in my conceptual model.

Future research should address these sample- and research-setting based limitations by examining team trait positive affect and project team development in larger studies (in terms of team-level sample size) grounded in non-military settings. Furthermore, future research should explore how contextual variables held constant in my empirical study might influence the conceptualization I have proposed. For example, future research might examine how the length of a project changes the relationship between team trait positive affect and changes in team learning behavior over time or the relationship between team trait positive affect and team effectiveness. Future research might also investigate the role played by team task type in my theory of team trait positive affect, team development and effectiveness.

Beyond addressing the limitations of my longitudinal empirical investigation, there are exciting avenues for future research, as described above, into additional mechanisms through which team trait positive affect might impact team effectiveness. While my theory

incorporates specific constructs from three of the most central construct spaces in the teams literature—team task development, team social development, and team regulation—team trait positive affect might shape team performance through other channels. For example, the current study focused on teams as relatively isolated entities, without connections to external information sources or leaders. It is possible that team trait positive affect encourages boundary spanning behavior and connections with external experts who might facilitate high team performance (Ancona & Caldwell, 1992). Or, team trait positive affect may buffer teams against the negative impact of team conflict (Cole et al., 2008), allowing for constructive criticism and voice when they are most relevant and desirable, such as during the midpoint transition (Jehn & Mannix, 2001). Finally, team trait positive affect might facilitate helping behaviors that spur high team performance (Ehrhart & Naumann, 2004). While there are a number of other possible candidate mechanisms through which team trait positive affect shapes team development and team effectiveness, it is possible that, through these many possible paths, there is equifinality in the relationship between team trait positive affect and team effectiveness.

In addition to incorporating and exploring the development of other constructs in relation to team trait positive affect, future research using experimental methods should test the mechanisms proposed in my conceptual model more directly than was possible in a field study. In particular, laboratory research should directly explore the role of positive affective experiences in influencing a shift away from team learning behavior during the midpoint transition through sacrificing. A mood induction approach, which has been particularly prominent in the literature on affect and creativity at the individual-level (Lyubomirsky et al., 2005) and also has been used successfully by teams researchers (Barsade, 2002) could directly test the causal role of positive affect in motivating changes in team direction at the midpoint. Following the transcription analysis approach often used in studies of midpoint transitions (Gersick, 1989, e.g.), researchers could further determine whether maximizing

and satisficing behaviors are evident during this time and whether such behaviors are linked to effective transitions.

Finally, while the current study examined differences between teams with respect to three types of developmental trajectories, future research might employ growth mixture modeling techniques (Muthén, 2004) to explore whether teams high in team trait positive affect have qualitatively different growth patterns across an integrated set of variables over time. Growth mixture modeling is an analytical technique for combining person-centered (e.g., cluster analysis) and variable-centered (e.g., confirmatory factor analysis) to identify distinct latent classes of subjects across a variety of variables. In a comprehensive analytical framework, researchers can explore antecedents and consequences of membership in a given latent class. With a sufficiently large sample, a study of team trait positive affect and project team development might employ growth mixture modeling to determine comprehensive developmental patterns, what leads teams to follow such patterns, and what the impact of these trajectories are on project team effectiveness.

Conclusion

Teams scholars are paying increasing attention to affective constructs in their theories and empirical studies (Barsade & Gibson, 2007). Yet, affect continues to play a peripheral role in most theories of team development and affective constructs often go unmeasured in empirical research; in the teams literature, affective constructs play second fiddle to cognitive constructs (Kozlowski & Ilgen, 2006). Grounded in the substantial literature on positive affect at the individual level and burgeoning research on positive affect in groups and teams, I proposed and tested a conceptual model of how team trait positive affect shapes project team development and influences project team effectiveness. The findings from my longitudinal empirical study, while preliminary given the size of my sample and,

in general, the paucity of research on team trait positive affect and team development, depict project teams as dynamic entities that grow and change in different ways over the course of their lives. A team's collective capacity to feel positively, my findings indicate, influences not only how it changes over time, but also how effective it is in completing its tasks. In combination, my conceptual model and my empirical results call into question affect's place at the periphery of teams theory and research; perhaps the wrong fiddler in sitting in the first chair.

Appendix A

Results of Supplementary Maximum Likelihood Analyses

In the tables that follow in this Appendix, I present the results of analyses done using a traditional (i.e., Frequentist) approach to growth modeling that is most often used in other quantitative studies of team development in the organizational behavior literature (e.g., Mathieu & Schulze, 2006; Mathieu & Rapp, 2009). Specifically, the following results are based on random coefficients growth models estimated using maximum likelihood techniques.

The presentation of results in these tables mirrors the structure and format of results presented using a Bayesian approach in my Results section. As can be seen in the tables below, the results of a typical frequentist approach yields, in most cases, the same substantive conclusions as the Bayesian analyses reported above in the body text of the Results section.

Table A.1: Results of MLE Models for Base Growth Trajectories^{ab}

	A. Positive Mood		B. Exploratory Search		C. Exploitative Refining	
	LL	AIC	LL	AIC	LL	AIC
1. Linear trend ^c	−34.63	75.25	−65.52	137.03	−43.64	93.28
2. Quadratic trend ^d	−36.36	80.71	−65.22	138.45	−44.91	97.82
3. Random change intercept ^e	−23.91	55.82	−56.22	122.43	−35.48	78.97
4. Random change slope ^f	−22.52	57.03	−49.45	112.89	−29.57	71.15
Selected Base Model	Model 3, Linear		Model 4, Quadratic		Model 3, Linear	

	D. Friendship Density		E. Team Efficacy	
	LL	AIC	LL	AIC
1. Linear trend ^c	−38.56	83.13	−111.55	229.11
2. Quadratic trend ^d	−40.11	88.22	−112.13	232.26
3. Random change intercept ^e	−14.04	36.08	−76.55	161.11
4. Random change slope ^f	−13.52	39.04	−73.75	159.50
Selected Base Model	Model 3, Linear		Model 4, Linear	

^a Team-level N = 33 × 3 time points^b Values are the model Log Likelihood (LL) and Akaike Information Criterion (AIC) for judging model fit.^c Linear trend model contains a fixed linear effect of time.^d Quadratic trend model adds a fixed quadratic effect of time.^e Random change intercept model allows the initial value of the criterion to vary across teams.^f Random change slope model allows the linear relationship between time and the criterion to vary across teams.

Table A.2: Results of MLE Growth Models Predicting Team Positive Mood over Time^{ab}

	A. Base Model				B. Prediction Model			
	Est.	SE	2.5%	97.5%	Est.	SE	2.5%	97.5%
Initial positive mood	3.86	0.06	3.75	3.97	3.86	0.05	3.75	3.97
Time	0.00	0.03	-0.06	0.06	0.00	0.03	-0.06	0.06
Team trait positive affect					0.34	0.18	-0.02	0.71
σ^2 , intercept	0.23		0.17	0.32	0.22		0.15	0.31
σ^2 , residual	0.24		0.20	0.28	0.24		0.20	0.28
Log Likelihood	-23.91				-22.92			
AIC	55.82				55.85			

^a Team-level N = 33 × 3 time points.^b Values are coefficient estimates (Est.), standard errors (SE), and 95% confidence intervals.

Table A.3: Results of MLE Growth Models Predicting Exploratory Search over Time^{ab}

	A. Base Model				B. Prediction Model			
	Est.	SE	2.5%	97.5%	Est.	SE	2.5%	97.5%
Initial exploratory search	3.09	0.08	2.93	3.25	3.09	0.08	2.93	3.25
Time, linear	0.37	0.10	0.16	0.58	0.37	0.10	0.16	0.58
Time, quadratic	-0.18	0.05	-0.27	-0.09	-0.18	0.05	-0.27	-0.09
Team trait positive affect					0.33	0.31	-0.31	0.96
Time $\times$ Team trait positive affect					-0.42	0.19	-0.81	-0.03
σ^2 , intercept	0.40		0.30	0.55	0.40		0.29	0.55
σ^2 , slope	0.25		0.18	0.36	0.24		0.16	0.34
$r_{intercept,slope}$	-0.56		-0.79	-0.20	-0.54		-0.78	-0.15
σ^2 , residual	0.21		0.17	0.27	0.21		0.17	0.27
Log Likelihood	-49.45				-48.38			
AIC	112.89				114.76			

^a Team-level N = 33 $\times$ 3 time points.^b Values are coefficient estimates (Est.), standard errors (SE), and 95% confidence intervals.

Table A.4: Results of MLE Growth Models Predicting Exploitative Refining over Time^{ab}

	A. Base Model				B. Prediction Model			
	Est.	SE	2.5%	97.5%	Est.	SE	2.5%	97.5%
Initial exploitative refining	3.94	0.07	3.79	4.09	3.94	0.07	3.80	4.07
Time, linear	0.17	0.04	0.09	0.25	0.17	0.04	0.09	0.25
Team trait positive affect					0.73	0.27	0.19	1.28
Time $\times$ Team trait positive affect					-0.22	0.16	-0.55	0.10
σ^2 , intercept	0.38		0.28	0.52	0.34		0.25	0.47
σ^2 , slope	0.19		0.13	0.29	0.19		0.12	0.28
$r_{intercept,slope}$	-0.78		-0.91	-0.50	-0.76		-0.90	-0.46
Variance, residual	0.20		0.16	0.25	0.20		0.16	0.25
Log Likelihood	-29.57				-27.38			
AIC	71.15				70.76			

^a Team-level N = 33 $\times$ 3 time points.^b Values are coefficient estimates (Est.), standard errors (SE), and 95% confidence intervals.

Table A.5: Results of MLE Growth Models Predicting Team Friendship Network Density over Time^{ab}

	A. Base Model				B. Prediction Model			
	Est.	SE	2.5%	97.5%	Est.	SE	2.5%	97.5%
Initial friendship density	2.98	0.06	2.86	3.09	2.98	0.05	2.87	3.09
Time	0.10	0.02	0.05	0.14	0.10	0.02	0.05	0.14
Team trait positive affect					0.51	0.20	0.10	0.91
σ^2 , intercept	0.29		0.22	0.38	0.26		0.20	0.35
σ^2 , residual	0.19		0.16	0.23	0.19		0.16	0.23
Log Likelihood	-14.04				-11.70			
AIC	36.08				33.39			

^a Team-level N = 33 × 3 time points.

^b Values are coefficient estimates (Est.), standard errors (SE), and 95% confidence intervals.

Table A.6: Results of MLE Growth Models Predicting Team Efficacy over Time^{ab}

	A. Base Model				B. Prediction Model			
	Est.	SE	2.5%	97.5%	Est.	SE	2.5%	97.5%
Initial learning behavior	3.71	0.13	3.44	3.97	3.71	0.12	3.46	3.95
Time, linear	0.12	0.05	0.02	0.22	0.12	0.05	0.02	0.22
Team trait positive affect					1.33	0.48	0.34	2.31
Time $\times$ Team trait positive affect					-0.18	0.20	-0.57	0.22
σ^2 , intercept	0.72		0.55	0.95	0.65		0.49	0.87
σ^2 , slope	0.21		0.13	0.34	0.21		0.13	0.34
$r_{intercept,slope}$	-0.42		-0.73	0.03	-0.37		-0.71	0.10
σ^2 , residual	0.26		0.21	0.34	0.26		0.21	0.34
Log Likelihood	-73.75				-70.87			
AIC	159.50				157.73			

^a Team-level N = 33 $\times$ 3 time points.^b Values are coefficient estimates (Est.), standard errors (SE), and 95% confidence intervals.

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