

A Theory, Measure, and Empirical Test of Subgroups in Work Teams

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Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor of Philosophy in the Department of
Business Administration in the Graduate School
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ABSTRACT

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Abstract

Although subgroups are a central component of work teams, they have remained largely unexamined by organizational scholars. In three chapters, a theory and measure of subgroups are developed and then tested. The theory introduces a typology of subgroups and a depiction of the antecedents and consequences of subgroups. The measure, called the subgroup algorithm, determines the most dominant configurations of subgroups in real work teams—those that are most likely to influence team processes and outcomes. It contrasts the characteristics within a subgroup or set of subgroups versus the characteristics between subgroups or a set of subgroups for every potential configuration of subgroups on every work team in a given sample. The algorithm is tested with a simulation, with results suggesting that it adds value to the methodological literature on subgroups. The empirical test uses the subgroup algorithm to test key propositions put forth in the theory of subgroups. First, it is predicted that teams will perform better when identity-based subgroups are unequal in size and knowledge-based subgroups are equal in size. Second, it is predicted that, although teams will perform better with an increasing number of both identity-based and knowledge-based subgroups, there will be a discontinuity in this linear function for identity-based subgroups: teams with two identity-based subgroups will perform more poorly than teams with any other number of identity-based subgroups. The subgroup algorithm is used to test these predictions in a sample of 326 work teams. Results generally support the predictions.

Dedication

This dissertation is dedicated to my parents, Bruce M. Carton and Dianne M. Carton, for inspiring me (to try very hard) to be a loving person and to question all assumptions.

Contents

Abstract	iv
List of Tables	x
List of Figures	xi
CHAPTER 1: A THEORY OF SUBGROUPS IN WORK TEAMS	1
A Typology of Subgroups in Work Teams	4
The Definition, Theoretical Basis, and Underlying Factors of Subgroups	4
Identity-based Subgroups	10
Resource-based Subgroups	12
Knowledge-based Subgroups	14
The Antecedents of Subgroups	18
The Formation of Subgroups from Faultlines	18
The formation of identity-based subgroups	22
The formation of resource-based subgroups	23
The formation of knowledge-based subgroups	24
The Configurational Properties of Subgroups	25
Considering Multiple Faultline Types and Multiple Subgroup Types Simultaneously	26
The Relationship between the Configurational Properties of Subgroups and Subgroup Processes	30
The Impact of Configurational Properties on Identity-based Subgroup Processes	32
The number of identity-based subgroups	32
Variation in the size of identity-based subgroups	32
The Impact of Configurational Properties on Resource-based Subgroup Processes	33

The number of resource-based subgroups	33
Variation in the size of resource-based subgroups	34
The Impact of Configurational Properties on Knowledge-based Subgroup Processes	35
The number of knowledge-based subgroups	35
Variation in the size of knowledge-based subgroups	36
Team-level Consequences of Subgroups	36
The Unique Effects of Each Subgroup Type on Individual Team Outcomes	37
The unique effects of identity-based subgroups	38
The unique effects of resource-based subgroups	39
The unique effects of knowledge-based subgroups	40
Combined Effects of the Three Subgroup Types on Individual Team Outcomes	42
Discussion	47
Implications for Research on Intergroup Behavior in Teams	48
Implications for Research on Team Faultlines	51
Implications for Research on Team Diversity	55
Managing Subgroups to Enhance Overall Team Effectiveness: The Role of Moderators	57
Future Extensions of the Theory of Subgroups	59
Conclusion	60
CHAPTER 2: A MEASURE OF SUBGROUPS IN WORK TEAMS	61
Review of Existing Measures	64
The Need for an Expanded Measure of Subgroups in Work Teams	65
Toward a Measure of Subgroups	69

The Subgroup Algorithm	70
Comparison between the Subgroup Algorithm and Existing Faultline Measures	77
The Subgroup Algorithm Compared to the Subgroup Strength Measure	77
Example	78
The Subgroup Algorithm Compared to the <i>Fau</i> Measure	79
Example	80
The Subgroup Algorithm Compared to the Distance Measure	84
Example	85
Discussion and Conclusions	86
Advancing Methodology in the Study of Team Effectiveness	86
The value added by the subgroup algorithm	86
Practical advantages of the subgroup algorithm for teams scholars	87
Advancing Theory in the Study of Team Effectiveness	89
CHAPTER 3: AN EMPIRICAL TEST OF SUBGROUPS IN WORK TEAMS	90
The Interplay between Subgroup Configuration and Subgroup Type	93
The Balance of Identity-based vs. Knowledge-based Subgroups	95
Identity-based subgroups	95
Knowledge-based subgroups	97
The Number of Identity-based vs. Knowledge-based Subgroups	98
Identity-based subgroups	98
Knowledge-based subgroups	99
Methods	100
Sample	101

Measures	103
Dependent variable: Team performance	103
Independent variables: Subgroup balance and number	104
Control variables	109
Results	109
Discussion	115
Subgroup Balance: When are Minorities and Majorities a Good Thing?	115
Subgroup Number: When is “More” Better?	116
Additional Contributions	117
Managerial Implications, Limitations, and Future Directions	119
Conclusion	120
APPENDIX	121
REFERENCES	127
BIOGRAPHY	137

List of Tables

Table 1: A Typology of Subgroups in Work Teams	9
Table 2: Overlap in Membership between Two Types of Subgroups	68
Table 3: Comparison of Robustness of Subgroup Algorithm with Subgroup Strength Measure and <i>Fau</i> Measure	79
Table 4: Comparison of Subgroup Algorithm with <i>Fau</i> Measure	81
Table 5: Comparison of Subgroup Algorithm with Distance Measure	83
Table 6: Correlations	111
Table 7a: Results for Balance of Subgroups: Teams with One or More Subgroups	112
Table 7b: Results for Balance of Subgroups: Teams with Two or More Subgroups	112
Table 8: Results for Number of Subgroups	114

List of Figures

Figure 1: The Antecedents of Subgroups in Work Teams	17
Figure 2: An Example of How a Faultline Causes Subgroups	21
Figure 3: Considering Multiple Faultline Types and Multiple Subgroup Types Simultaneously	28
Figure 4: Examples of Two Teams with Different Configurations of Faultline Types and Subgroup Types	53
Figure 5: Hypotheses	96
Figure 6: The Number of Subgroups: Actual Means	115

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CHAPTER 1: A THEORY OF SUBGROUPS IN WORK TEAMS

As organizations continue to turn to work teams to accomplish key objectives, researchers have converged on the notion that team processes and outcomes are strongly influenced by subgroups (Gibson & Vermeulen, 2003; Lau & Murnighan, 2005). Empirical research suggests that subgroups, which are defined as distinct subsets of team members that are each characterized by a unique form or degree of interdependence (Lau & Murnighan, 1998), often emerge at some point during team engagement (Campion, Papper, & Medsker, 1996; Edmondson, 1999). Recently, much of the research relevant to subgroups has been conducted by scholars who study faultlines, which are hypothetical dividing lines that have the potential to create subgroups, such as the gender divide on a team with two men and two women (Lau & Murnighan, 1998; Li & Hambrick, 2005). Other scholars have studied subgroups with approaches that extend or depart from the faultline model in contexts such as team learning (Gibson & Vermeulen, 2003), team decision making (Kameda & Sugimori, 1995), distributed collaboration (Cramton & Hinds, 2005; O'Leary & Mortensen, 2010), social perception (Park, Ryan, & Judd, 1992), perceptions of justice (Huo, Smith, Tyler, & Lind, 1996), and knowledge sharing (Phillips, Mannix, Neale, & Gruenfeld, 2004).

Although subgroups have been invoked in a wide array of literatures, there are two specific limitations in terms of how they are studied. First, the majority of research on subgroups in literatures such as faultlines (Homan, van Knippenberg, Van Kleef, & De Dreu, 2007; Li & Hambrick, 2005), learning (Gibson & Vermeulen, 2003), and distributed collaboration (Cramton & Hinds, 2005), has invoked subgroups as either antecedents of certain outcomes (e.g., conflict) or consequences of team composition

(e.g., faultlines). As a consequence, the subgroup itself has often received little attention as a stand-alone construct and instead has been invoked as a “one-size-fits-all” concept that can represent any subset of members in a work team. For example, faultline scholars have clarified how subgroups *form* (when work team members share characteristics with some members but not others; Lau & Murnighan, 1998), yet they have not focused on the processes of subgroups themselves. That is, faultline researchers have not assumed that the way members interact within and between subgroups is characterized by systematic or meaningful variation (e.g., social interaction vs. knowledge sharing).

Second, existing research that has delved deeper in terms of uncovering key components of subgroups has not yet been integrated into a holistic framework or model. Two important concepts that have not yet been integrated are *subgroup type* and *subgroup configurational properties*. Some scholars have suggested that there is more than one type of subgroup, including subgroups based on social categories versus subgroups based on functional expertise (Bezrukova, Jehn, Zanutto, & Thatcher, 2009; Choi & Sy, 2009; Phillips et al., 2004; Sawyer, Houlette, & Yeagley, 2006), and other scholars have studied how configurational properties (variation in the number and size of subgroups) can affect outcomes (Kameda & Sugimori, 1995; Mannix, 1993; Menon & Phillips, 2010; O’Leary & Mortensen, 2010; Polzer, Crisp, Jarvenpaa, & Kim, 2006). Yet no research has explored whether different subgroup types are affected in similar or different ways by these configurational properties.

Taken together, these limitations suggest that our understanding of the nature, variation, and properties of the construct of the subgroup is not in line with its significance to work teams. As a consequence, we suggest that the subgroup needs to be

reconceptualized. To do this, we introduce a theory of subgroups in which we propose that there are three types of subgroups: identity-based, resource-based, and knowledge-based. Each subgroup type is differentiated by unique theoretical origins and processes. Further, each subgroup type is affected differently by the same configurational properties (the number of subgroups and variation in the size of subgroups). A theoretical analysis that brings subgroups to the foreground in research on work teams can develop a common terminology for teams scholars and facilitate the reconciliation and integration of findings across the broad array of literatures that speak to the antecedents and the consequences of subgroups.

Moreover, unpacking the subgroup construct can explain important variance in team outcomes and resolve a number of questions that remain unanswered due to assumptions made in existing research. As illustrations, we describe how our theory can explain why two teams with the same amount of task conflict can have very different levels of success; why two teams that each have a configuration of one large subgroup (a numerical majority) and one small subgroup (a numerical minority) can experience widely different levels of learning; why two teams with the same number of subgroups can experience very different levels of efficiency; and why two teams with similar faultline strengths can experience very different levels of success. In order to build the foundation necessary to surface these types of insights, we seek to accomplish two key objectives. First, we build a typology that captures the three dominant forms of subgroups. Second, we outline how each of these three subgroups evolves in teams—from the emergence of each type to the impact of each type on team outcomes.

A Typology of Subgroups in Work Teams

The first part of our theory is a typology that captures the range of subgroups in work teams. According to Doty and Glick (1994), a typology identifies the dominant forms of a construct and serves as a platform for considering the independent properties of each type as well as the interdependence of the different types. In this section, we elaborate on the definition, core characteristics, and theoretical basis of subgroups in order to identify the dominant types of subgroups.

The Definition, Core Characteristics, and Theoretical Basis of Subgroups

Since no commonly accepted definition of subgroups exists in the literature on work teams, we suggest that a set of two or more organizational members have to meet two criteria in order to be considered a subgroup. First, they must be a *subset* of members of the same work team, whereby a work team is a group (e.g., project team or management team) whose membership and task are formally recognized by the organization (Cohen & Bailey, 1997; Kozlowski & Bell, 2003). Second, given that all members in a team have some basic level of interdependence, a subset of members can be considered a subgroup only if they are characterized by a form or degree of interdependence that is unique when compared to that of other members. For example, a subgroup exists if a set of members communicates differently with each other than with other team members because they share a cultural value, scarce resource, or knowledge frame that is unique from those shared by other team members.

This definition provides important context for understanding two characteristics of subgroups that guide our identification of the theoretical basis of subgroups. The first characteristic is the size of subgroups. Theory and research on faultlines suggests that

subgroups are typically formed according to the natural grouping preferences of individuals (Lau & Murnighan, 1998). People strongly prefer groups composed of between two and three members, and rarely choose to integrate into groups with more than six members (Desportes & Lemaine, 1988; Levine & Moreland, 1998). Compared with larger groups, groups of this size are more manageable (James, 1951), more interpersonally satisfying (Shaw, 1964), promote a greater sense of distinctiveness (Brewer, 1991), and prevent process loss and coordination problems (Latane, Williams, & Harkins, 1979). While remaining manageable, groups of this size also give members enough clout to have their positions and viewpoints heard by others (Azzi, 1993). In short, subgroups can be understood by examining groups that are found to have between two and six members, such as coalitions (Tichy, Tushman, & Fombrun, 1979).

The second characteristic is that work teams often have at least two subgroups. Although there are instances in which teams have only one subgroup (Phillips et al., 2004), many teams are likely to have multiple subgroups given that the sizes of groups that members prefer (two to six members) are often much smaller than the sizes of many work teams, which often have ten to fifteen members (De Dreu, 2007; Farrell, Schmitt, & Heinemann, 2001; Politis, 2003; Rentsch & Klimoski, 2001; Stewart & Barrick, 2000). The presence of multiple subgroups creates an important dynamic in work teams. Given that all members of a work team share a common goal (Kozlowski & Bell, 2003), different subgroups must interact, rely on each other for task responsibilities, and otherwise remain strongly aware of one another. This lies in contrast to disparate, disconnected groups that are not *subgroups* because—since they are not subsets of a broader group—they are unlikely to be highly dependent upon one another. For these

reasons, it is more informative to study the *relationships* among subgroups than to study any one subgroup in isolation. The most appropriate theories for understanding the relationships between interdependent groups are theories of intergroup behavior, which we adopt to conceptualize inter-*subgroup* behavior within work teams.

To develop a typology of subgroups, we conducted two literature reviews based on the two characteristics identified above related to the (1) size of subgroups and the (2) theoretical relevance of intergroup behavior for conceptualizing subgroups. First, we reviewed literatures that incorporate groups typically composed of between two and six members. These literatures included social networks, diversity, faultlines, negotiations, decision making, innovation, knowledge sharing, and virtual teams (e.g., Arrow, McGrath, & Berdhal, 2000; Dahlin, Weingart, & Hinds, 2005; Hart & Van Vugt, 2006; Kerr & Tindale, 2004; Levine & Moreland, 1998; Li & Hambrick, 2005; McPherson, Smith-Lovin, & Cook, 2001; Stevenson, Pearce, & Porter, 1985). We identified a number of distinct concepts, such as clusters from research on social networks and blocs from research on decision making.

Second, we reviewed the literature on intergroup behavior. Our review indicated that there are three general classes of intergroup theories. The first class is studied largely by social and organizational psychologists, and includes superordinate/subordinate theories of identification, theories of multi-group identification such as optimal distinctiveness, and studies of outgroup homogeneity (e.g., Brewer, 1991; Hogg & Terry, 2000; Messick & Mackie, 1989). Most of these theories rest on tenets that are congruent with *social identity theory* (Tajfel & Turner, 1986), which posits that groups form when

members share a common identity. We therefore suggest that *identity-based subgroups* are one type of subgroups.

The second class of intergroup theories is typically studied by organizational sociologists, and includes realistic group conflict theory (Campbell, 1965; Esses, Jackson, & Armstrong, 1998) and theories of inequality, stratification, classes, and organizational ranks (e.g., Blau, 1977; Kluegel & Smith, 1986). These theories are congruent with *social dominance theory* (Sidanius & Pratto, 1999), which presumes that distinct social groups are formed and sustained according to differences in groups' abilities to claim resources. Because theory on social dominance suggests that groups are differentiated according to resources, we suggest that *resource-based subgroups* are a second type of subgroups.

The third class of intergroup theories is typically studied by researchers interested in the evolution of organizations, and includes theories of adaptation and requisite variety (Ashby, 1958; Volberda & Lewin, 2003). These theories can be positioned within the overarching rubric of *information processing* (Galbraith, 1974) because they relate to how organizations have developed specialized units to adapt to specific domains of knowledge, such as accounting and customer service. Because theory on information processing suggests that groups are differentiated according to knowledge, we suggest that *knowledge-based subgroups* are a third type of subgroups.

In an effort to integrate the findings from our review of the literature on groups consisting of two to six members with our review of the literature on intergroup behavior, we introduce a typology in Table 1, which suggests that the three intergroup theories highlighted above (social identity, social dominance, and information processing) determine whether the processes associated with a subgroup are theoretically similar to,

or different from, another subgroup. For example, cliques and social subgroups are both identity-based subgroups because subgroups are characterized by processes related to social identity. However, cliques and factions are different types of subgroups because factions are resource-based subgroups characterized by processes related to social dominance.

Table 1: A Typology of Subgroups in Work Teams

Type of Subgroup	Examples of Subgroup Type	Key Characteristics of Subgroup Type
<i>Identity-based Subgroups</i>	<ul style="list-style-type: none"> Cliques (Tichy et al., 1979) Relational subgroups (Choi & Sy, 2009) Social subgroups (Phillips et al., 2004) Values homophilies (Lazarsfeld & Merton, 1954) 	Inter-subgroup behavior is characterized by social identity (e.g., ingroup favoritism and bias against outgroups).
<i>Resource-based Subgroups</i>	<ul style="list-style-type: none"> Blocs (Ulmer, 1965) Coalitions (Finkelstein, 1992) Factions (Li & Hambrick, 2005) Status homophilies (McPherson et al., 2001) 	Inter-subgroup behavior is characterized by social dominance (e.g., hierarchical stratification between subgroups based on power).
<i>Knowledge-based Subgroups</i>	<ul style="list-style-type: none"> Clusters (Tichy et al., 1979) Cohorts (Gibson & Vermeulen, 2003) Informational subgroups (Bezrukova et al., 2008) Job-function subgroups (Sawyer et al., 2006) 	Inter-subgroup behavior is characterized by information processing (e.g., competition between mental models).

Identity-based Subgroups

The behavior within and between identity-based subgroups is characterized by social identity (Tajfel & Turner, 1986). Social identity theory posits that individuals perceive others as belonging to groups that represent shared beliefs, values, and a sense of the social self. People make quick determinations about which individuals belong to their social group in order to simplify the social world and affiliate with those who they believe share the same sense of identity (Hogg & Terry, 2000). In the context of work teams, social identity theory would suggest that members enhance their self-worth by believing that they belong to a distinctive subgroup while comparing themselves favorably to members of other subgroups (Ashforth & Mael, 1989). Consider an eight-member global marketing team, in which there are minimal differences between members in terms of resources and knowledge. This team has two subgroups. One subgroup includes four members who possess one set of cultural beliefs, and the other subgroup includes four members who possess a set of cultural beliefs that is distinct from that of the first subgroup. Given that organizational members often shape their self-concepts according to the smallest groups to which they belong (Cooper & Thatcher, 2010), the members of each subgroup are prone to base their self-concepts at least in part according to their subgroups' identities (Turner & Onorato, 1999).

Research related to identity-based subgroups has been conducted by scholars of diversity (Harrison, Price, & Bell, 1998; Phillips et al., 2004), faultlines (Bezrukova et al., 2009; Choi & Sy, 2009; Chrobot-Mason, Ruderman, Weber, & Ernst, 2009; Pearsall, Ellis, & Evans, 2008; Sawyer et al., 2006), intergroup conflict (Hogg & Terry, 2000), and social networks (Lazarsfeld & Merton, 1954; McPherson et al., 2001; Tichy et al., 1979).

Table 1 presents four representative examples. A prototypical example is the *clique*. Cliques are formed according to the values that are presumed to be most integral to members' individual identities and self-concepts (Tichy et al., 1979; Ulmer, 1965). Cliques are often studied in the context of social relationships at work, such as friendships, because of the assumption that it is the sense of one's social self that drives his or her clique membership. Such a perspective has been especially popular in research on social networks, which has drawn a firm distinction between task-based and socially-based channels of communication (Tichy et al., 1979).

Three other examples of identity-based subgroups are values homophilies, relational subgroups, and social subgroups. *Values homophilies* are comparable to cliques in that they relate to network connections that are developed according to core values (Lazarsfeld & Merton, 1954; McPherson et al., 2001). Members of the same values homophily in a work team can fulfill motives for social support, friendship, and identification. Choi and Sy (2009) proposed that *relational subgroups* are based on social affiliation and a sense of overlapping identity. Choi's and Sy's key contribution was to tie relational subgroups to team conflict by highlighting that variance in relational conflict—but not task conflict—can be explained by the degree to which there are schisms between relational subgroups. Members form *social subgroups* with those who share similar attitudes and enduring beliefs, and therefore these subgroups have a profound influence on communication—especially that which is conducted through informal channels (Phillips et al., 2004). For instance, members of a social subgroup with one set of cultural beliefs may feel little personal attachment to members of a social subgroup with another set of cultural beliefs, and may therefore strongly favor interacting with those who share

their same identity both within and outside of structured time with the team (e.g., team meetings).

Resource-based Subgroups

The behavior within and between resource-based subgroups is characterized by social dominance theory (Levin, Federico, Sidanius, & Rabinowitz, 2002), which posits that socially dominant groups sustain inequality between themselves and subordinate groups by controlling access to finite resources, such as power, materials, and status (Pratto & Shih, 2003). Consider an eight member decision making team with two subgroups. One subgroup is composed of two members who are senior partners and have the greatest input regarding when to bring an expensive new product to market. The other subgroup is composed of six members who are assigned with the task of gathering and assimilating information, but do not have the power to make decisions. Whereas this is an example of a clear hierarchy of subgroups already being in place, we note that social dominance theory is also relevant when members attempt to create a hierarchy of subgroups that does not already exist. It is also important to note that, whereas social dominance theory typically emphasizes the attainment or sustainment of inequality that is unjust, we incorporate the tenets of theory on dominance complementarity (Kiesler, 1983) to suggest that hierarchies of subgroups in work teams can be fair and functional as much as they can be unfair and dysfunctional. This is because both dominant and subordinate subgroups can benefit from the predictability and structure available when there are differences in resources, such as status and power (Bunderson & Boumgarden, 2009; Tiedens & Fragale, 2003).

Research that can further inform this conceptualization of resource-based subgroups has been conducted by scholars of demography (Blau, 1974), decision making (Azzi, 1993; Gamson, 1961; Kameda & Sugimori, 1995; Ulmer, 1965), power and influence (Finkelstein, 1992), social networks (McPherson et al., 2001; Tichy et al., 1979), and joint ventures (Li & Hambrick, 2005). Table 1 presents four representative examples. A prototypical example is the *coalition*. Coalitions have been studied in a variety of contexts, such as bargaining (Gamson, 1961), social networks (Tichy et al., 1979), decision making (Mannix, 1993), and top management teams (Finkelstein, 1992). In each of these contexts, coalitions are viewed as subgroups that serve an instrumental purpose for members—a way to acquire resources, such as supplies or power, so that members have the leverage needed to attain other objectives.

Three other examples are factions, status homophilies, and blocs. *Factions* emerge when members ally to gain more power in the context of team politics (Li & Hambrick, 2005). For example, a team may break into distinct factions when one set of members seeks access to materials that another set of members possesses. *Status homophilies*, which have been studied in the context of social networks, can represent subgroups in which a hierarchy is assumed—that is, one or more subgroups have greater status than others. In addition to status, dominant status homophilies nearly always possess other critical resources (McPherson et al., 2001), and so members of dominant status homophilies are likely to have greater influence within a work team than members of subordinate status homophilies. *Blocs* emerge when members align to gain greater power in team decision making (Ulmer, 1965). In this way, blocs serve as alliances that team members use to accrue resources that they cannot gain individually. For instance,

six team members who each want to persuade a dominant two-member bloc of supervisors into delaying a product's launch may organize into a large bloc in order to gain "power in numbers."

Knowledge-based Subgroups

The behavior within and between knowledge-based subgroups is characterized by *information processing*. Although information processing can be used to describe diversity in individual perspectives, its tenets are frequently applied to explain intergroup behavior (for a review, see Hinsz, Tindale, & Vollrath, 1997). According to the principle of requisite variety (Ashby, 1958), organizations adapt to various environmental demands, resulting in distinct entities, such as units and functions, that have unique ways of filtering and processing knowledge. In work teams, members of different knowledge-based subgroups use unique technical languages, cues, and symbols (Dougherty, 1992; Galbraith, 1974). They have different ways of interpreting information and different modes of acquiring and distributing knowledge (Huber, 1991). For example, consider an eight-member cross-functional team with four subgroups of two members each. Two members are marketing analysts, two are accountants, two are engineers, and two are from finance. These subgroups are likely to be divided according to technical language, symbols, standards of communication, task-based knowledge, and approaches to problem-solving (Homan et al., 2007; March & Simon, 1958).

Research that can be brought to bear on our conceptualization of knowledge-based subgroups has been conducted by scholars of learning (Gibson & Vermeulen, 2003; Huber & Lewis, 2010), diversity (Gruenfeld, Mannix, Williams, & Neale, 1996;

Phillips et al., 2004), faultlines (Bezrukova et al., 2009; Choi & Sy, 2009; Homan et al., 2007; Sawyer et al., 2006), social networks (Balkundi, Kilduff, Barsness, & Michael, 2007; Burt, 1978; Roberson & Colquitt, 2005; Tichy et al., 1979), and group cognition (Nemeth, 1986; Peterson & Nemeth, 1996). Table 1 presents four representative examples. A prototypical example is the *cohort*. A recent definition of the cohort adapted the longstanding notion of a set of employees who enter an organization at the same time (McCain, O'Reilly, & Pfeffer, 1983) to describe work team members who share a similar interpretative framework, define problem spaces in similar ways, and share similar cognitive schemas (Gibson & Vermeulen, 2003).

Three other examples are informational subgroups, clusters, and job-function subgroups. *Informational subgroups* are formed according to attributes that “vary in how relevant they are to the tasks performed by a group and in how much impact they may have on task-related employee behavior” (Bezrukova et al., 2009: 36). Informational subgroups subsequently drive the way that members approach task-related factors, such as knowledge sharing. Similar to informational subgroups, *clusters* are subgroups that are formed according to patterns of knowledge sharing (Tichy et al., 1979). Finally, *job-function subgroups* are formed because the nature of a team’s task often mandates that members be organized into subgroups based on highly specialized knowledge, training, and skills (Sawyer et al., 2006). A member of a job-function subgroup of engineers may have difficulty communicating her subgroup’s preference for a certain type of engine for a new car design to a subgroup of marketers. Communication difficulties may not exist because members of separate subgroups have different identities or perceive rifts over resources, but because communicating about the engine’s perceived assets may require

engineering jargon (e.g., discussion consisting of terms like “oxidizers” and “compression”) that is not familiar to those who work in marketing.

With a typology of subgroups constructed, we now outline a model of subgroups in work teams. Figure 1 depicts how the three subgroup types and their associated processes evolve. There are three basic stages: antecedents, subgroup process, and consequences. We devote a section of the paper to each stage.

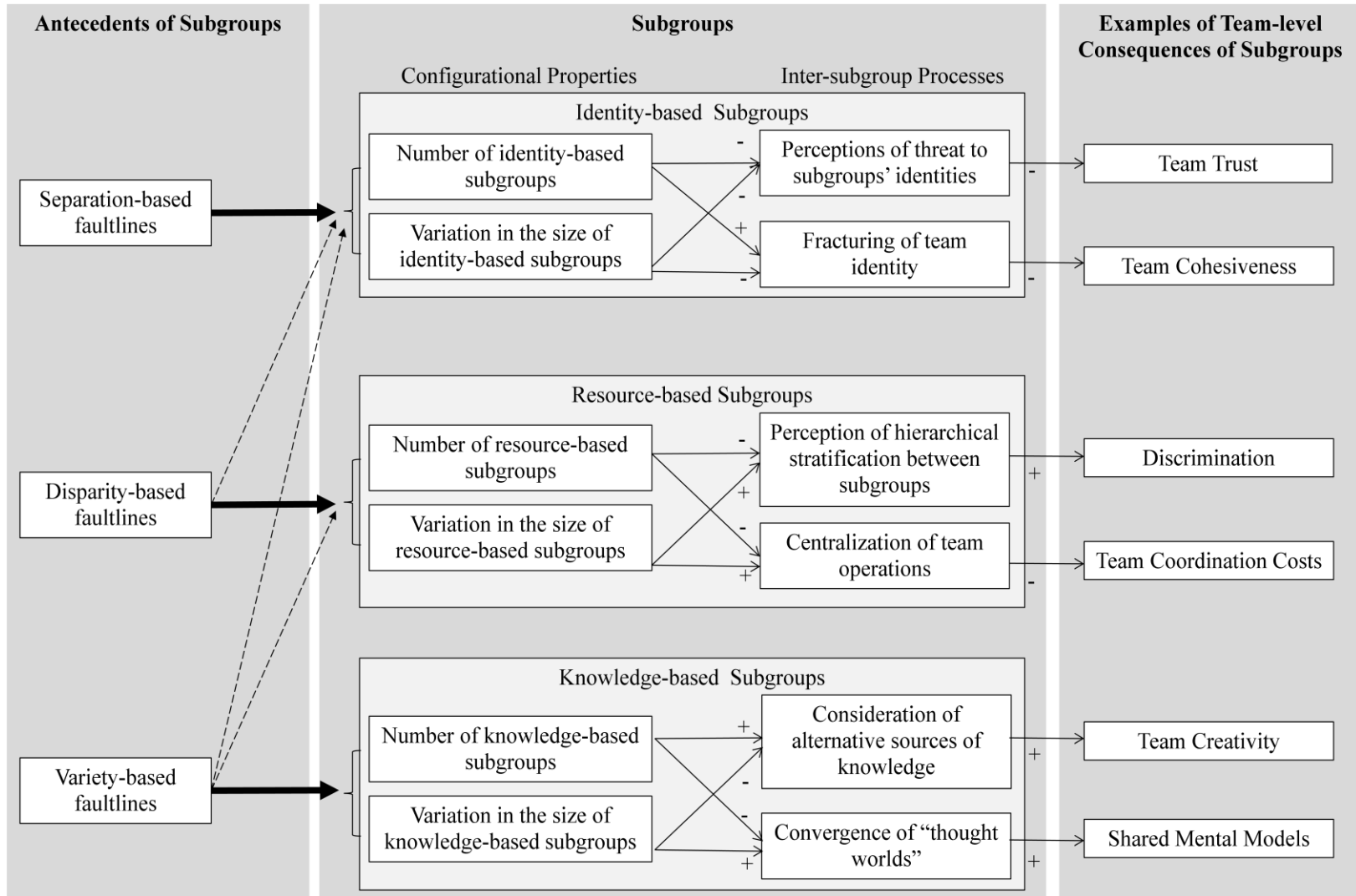


Figure 1: The Antecedents and Consequences of Subgroups in Work Teams

The Antecedents of Subgroups

We articulate two basic processes that occur simultaneously: how faultlines cause subgroups and how subgroups emerge from faultlines in specific configurations. That is, faultlines determine not only which of the three subgroup types emerge in a given team, but also the number of subgroups of each type and the size of the subgroups of each type. Our analysis of both of these components integrates theory on faultlines (Lau & Murnighan, 1998) and diversity (Harrison & Klein, 2007).

The Formation of Subgroups from Faultlines

The faultline model (Lau & Murnighan, 1998) provided initial theory regarding how subgroups emerge within work teams. Faultlines are hypothetical dividing lines that exist on attributes of diversity, such as the divide between two male marketers and two female engineers based on both gender and functional expertise. Whereas the faultline model is premised on the notion that hypothetical divisions exist in the same basic way on all attributes of diversity (Lau & Murnighan, 1998), we suggest that three types of faultlines exist on three different types of diversity: separation, disparity, and variety. Separation represents a “horizontal” continuum related to the values that team members possess (e.g., cultural values). Disparity represents a “vertical” continuum of traits related to what resources team members possess (e.g., status and decision power). Variety represents qualitatively distinct knowledge related to how team members think vis-à-vis their environment (e.g., functional expertise).

Some traits nearly always represent a certain form of diversity (Harrison & Klein, 2007). For example, cultural values represent separation because they reflect the attitudes

and positions with which people identify; status and power represent disparity because they reflect hierarchical stratification; and functional expertise represents variety because qualitatively distinct functions (e.g., accounting versus marketing) have arisen to adapt to distinct informational domains. However, other traits, particularly the demographic variables of age, gender, race, and tenure, can represent *more* than one type of diversity. For example, age can indicate separation (older workers may be more conservative than younger workers), disparity (older workers may possess more resources because they are higher in the organization's hierarchy), or variety (older workers may have been trained with entirely different procedures and approaches to problem solving than younger workers). Thus, as Harrison and Klein (2007) note, careful attention should be paid to the context when determining whether a variable represents separation, disparity, or variety, or more than one diversity type at the same time.

We adapt each of the three constructs of diversity identified by Harrison and Klein (2007) to the following assumption: faultlines exist when members share the same (or very similar) traits with some—but not all—members of their work team. In turn, we suggest that there are three types of faultlines: separation-based, disparity-based, and variety-based. Consider one example of each. Separation-based faultlines would exist if one subset of members shares one set of cultural values and another subset shares a different set of cultural values. A disparity-based faultline would exist if one subset of members shares extreme power and another subset of members has little power. A variety-based faultline would exist if one subset of members shares one functional expertise and another subset of members shares a different functional expertise.

Faultlines are not subgroups. As opposed to being related to active, dynamic inter-subgroup behavior, faultlines are *hypothetical* divisions based on inputs. That is, faultlines exist with respect to team composition, not behavior. Actual subgroups emerge when faultlines are “activated” by work team processes or the team context (Lau & Murnighan, 1998). For example, resource-based subgroups are likely to form from faultlines in the context of decision making because decisions are often influenced by those with more resources. If faultlines are not activated, then they lie “dormant” and do not lead to subgroup formation (Lau & Murnighan, 1998). We propose that a faultline type can be immediately activated into a given subgroup type only if there is a conceptual link between the subgroup type and the type of diversity that underlies the faultline type. For example, there is a conceptual link between disparity, which relates to differences in terms of resources, and resource-based subgroups. As shown in Figure 1, we illustrate six important relationships between faultlines and subgroups. Figure 2 provides an illustration.

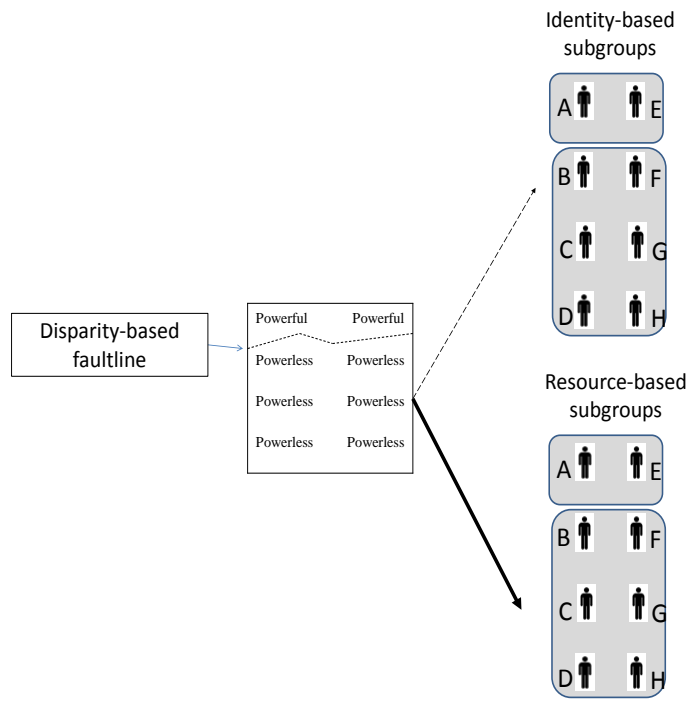


Figure 2: An Example of How a Faultline Causes Subgroups

The formation of identity-based subgroups. Social identity describes intergroup behavior based on the social factors most important to, or representative of, the self-concepts of team members. Identity-based subgroups form when team processes (e.g., an informal conversation) or cues from the team's context (e.g., primes that make identity-based differences salient) make members aware that they share these core characteristics with some members but not others (Hogg & Terry, 2000).

Figure 1 illustrates the likelihood that each type of faultline will be activated to form identity-based subgroups. An identity-based subgroup will only be activated by a faultline if that faultline represents something important to, or representative of, a social identity. Although all three faultlines can relate to identity, separation-based faultlines are more closely related to identity than disparity-based and variety-based faultlines. People feel the strongest attachment to those who they feel share the same values because values most closely represent core self-evaluations (Judge, Bono, Erez, & Locke, 2005). In this sense, people are likely to view others who share similar values as being in their identity-based subgroup. Separation-based faultlines therefore have a high likelihood of being activated into identity-based subgroups.

Disparity-based factors, such as status and power, are sometimes central to identity (Dovidio, Gaertner, & Validzic, 1998). For instance, having prominent social status is often integral to peoples' identities. However, the conceptual overlap between disparity and social identity is not as strong or as consistent as the link between separation and social identity because people sometimes reject that their possession of key resources is self-defining. This could hold for members that have both an advantageous and disadvantageous hold on resources. Disparity-based faultlines therefore

have a moderately high likelihood of being activated into identity-based subgroups and are less likely to be activated to form identity-based subgroups than separation-based faultlines. Variety-based factors, such as expertise, can also be important aspects of peoples' social identities (Dutton, Roberts, & Bednar, 2010). However, these characteristics often do not define identity (Ashforth & Kreiner, 1999). Variety-based faultlines therefore have a moderately high likelihood of being activated into identity-based subgroups, and are less likely to be activated to form identity-based subgroups than separation-based faultlines.

The formation of resource-based subgroups. Social dominance describes intergroup behavior based on specific resources that structure or reinforce a hierarchy in which certain subgroups are empowered and others are disenfranchised. Resource-based subgroups form when team processes reinforce the dominance of one subset of members, or finite resources induce haggling that can potentially create a hierarchy. Given that most collectives in organizations (departments, divisions, teams, and other subunits) require some hierarchical structure to facilitate decision making and the execution of critical task operations, any team decision can activate a hierarchy of subgroups because subgroups with critical resources will be in a better position to influence decisions. Resource-based subgroups can also form when constraints on key resources emerge. For instance, team management may restrict the pool of money allocated for financing travel, causing team members to haggle for leverage.

Figures 1 and 2 illustrate the relationships between faultlines and resource-based subgroups. A resource-based subgroup will only emerge from a faultline if that faultline

represents a resource. The three faultline types represent resources to different extents. Disparity relates most closely to the resources that correspond to hierarchy, especially power and status (McGee & Galinsky, 2009). In general, members with greater power, status, and authority (e.g., two senior managers) are more likely to emerge to be in dominant subgroups than members with less power, status, and authority (e.g., two research associates). Thus, disparity-based faultlines have a high likelihood of being activated to form resource-based subgroups.

We suggest that there is no direct relationship between separation-based faultlines and resource-based subgroups, as differences in terms of values—such as differences with respect to the stances that people take on a given topic—are not relevant to a hierarchy in any clear way. Variety-based faultlines can be triggered to create resource-based subgroups, especially when a form of variety, such as information, can be concentrated in a few members at the expense of the rest of the team. Organizations give priority to individuals who have important information or knowledge, rendering it easy to create hierarchical stratifications based on differences in information (Pfeffer, 1981). However, variety often relates simply to differences in thought—usage of different symbols, scripts, and technical terms—and is often not directly related to the creation or reinforcement of hierarchies in teams. Thus, variety-based faultlines have a moderately high likelihood of being activated to form resource-based subgroups.

The formation of knowledge-based subgroups. Information processing relates to how different subgroups interact using distinct scripts and information. Knowledge-based subgroups form from team processes which reinforce that different subsets of

members have unique cognitive schema and ways of approaching problem solving. For example, division of labor can trigger knowledge-based subgroups by steering members toward those who share the same symbols, scripts, knowledge frames, and ways of interpreting and acquiring knowledge. Indeed, merely the *expectation* that knowledge sharing will be partitioned along the demarcations of specialized expertise during task engagement is likely to be all that is needed for knowledge-based subgroups to form.

Figure 1 illustrates the relationships between faultlines and resource-based subgroups. A knowledge-based subgroup will only emerge from a faultline if that faultline represents knowledge. Variety relates most closely to knowledge because it is germane to factors that drive team members' acquisition of scripts and technical expertise. Teams are designed with variety in order to capitalize on unique expertise and devise task combinations that would otherwise not be possible. Variety-based faultlines therefore have a high likelihood of being activated to form knowledge-based subgroups. We suggest that there is no direct relationship between separation-based faultlines and knowledge-based subgroups or between disparity-based faultlines and knowledge-based subgroups, as these faultlines are not inherently characterized by differences in how members think about problems or what members know.

The Configurational Properties of Subgroups

Faultlines not only create specific subgroup types, but they also determine how subgroups are configured in terms of the number of subgroups of each type as well as the size of the individual subgroups of each type. The number of faultlines of a specific type

determines the number of subgroups of that type, and the location of the faultline or faultlines determine variation in the size of subgroups of that type.

The number of subgroups simply relates to whether a team has a small or large number of subgroups of a specific type. Variation in the size of subgroups represents a continuum in which one extreme—no variation in size—is when a team has equally-sized, perfectly balanced subgroups (e.g., two subgroups with the exact same number of members in each subgroup) and the other extreme—maximum variation in size—is when there are very small and very large subgroups. Consistent with research in sociology and diversity (Blau, 1978; Harrison & Klein, 2007), we consider increasing variation in the size of resource-based subgroups to only occur when the smaller subgroups are the more dominant subgroups (i.e., they have a greater concentration of resources than the other subgroups).

Considering Multiple Faultline Types and Multiple Subgroup Types Simultaneously

A given team may have only one subgroup type. There are two ways for only one subgroup type to form. Some teams are likely to only have one faultline type, and this faultline type may only trigger one subgroup type. For example, a team may only have a disparity-based faultline, and this faultline may only trigger resource-based subgroups (and not identity-based subgroups). Alternatively, a team may have two or three faultline types, yet only one subgroup type emerges. For example, a team may have all three faultline types, yet only resource-based subgroups emerge.

Additionally, two subgroup types or all three subgroup types can exist at the same time. There are two ways for multiple subgroup types to form. First, multiple faultline types can cause multiple subgroup types. Consider the team in Figure 3, which has all

three faultline types. The most likely scenario (configuration 1) is that separation-based faultlines would cause identity-based subgroups, disparity-based faultlines would cause resource-based subgroups, and variety-based faultlines would cause knowledge-based subgroups. The second way for multiple subgroup types to co-exist is for more than one subgroup type to emerge from a *single* faultline type. For example, suppose that only the variety-based faultline in Figure 3 was activated. It could potentially form all three subgroup types at the same time.

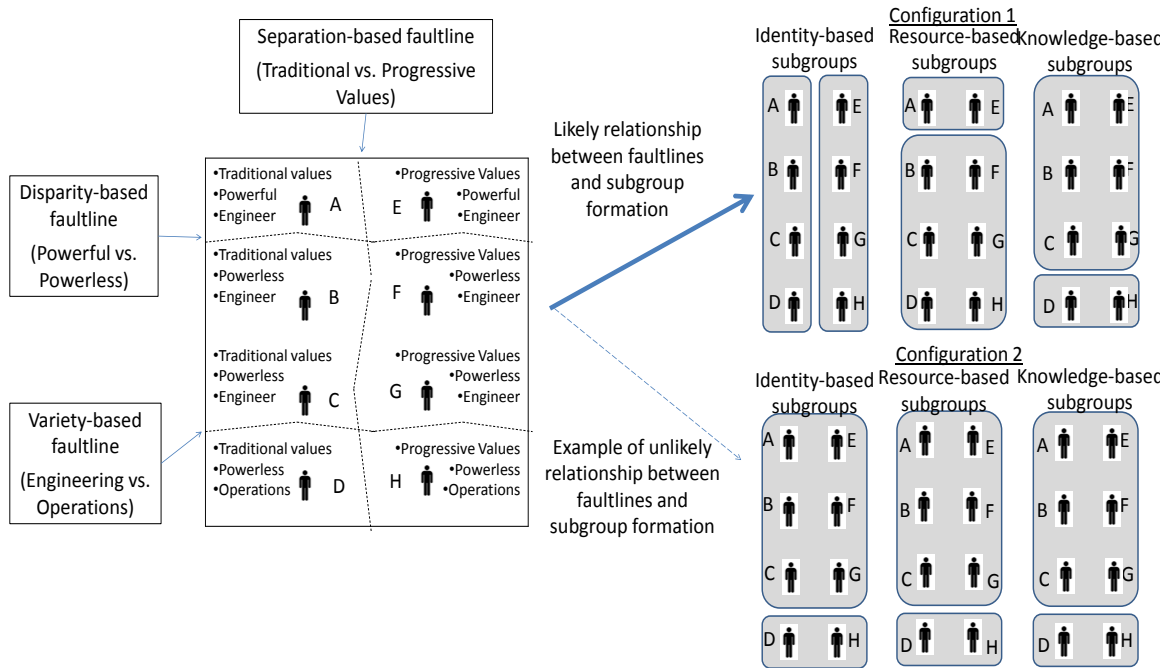


Figure 3: Considering Multiple Faultline Types and Multiple Subgroup Types Simultaneously

An important factor becomes apparent when comparing Configuration 1 and Configuration 2 in Figure 3: the degree to which the demarcation between members of different subgroups of one subgroup type aligns with the demarcation between members of different subgroups of a different subgroup type. The demarcation between subgroups is different for the three subgroup types for the first example, and identical for all three subgroup types for the second example.

Consistent with theory on faultlines, we suggest that, for each subgroup type, the demarcation between members of different subgroups is likely to remain the same until the team disbands (cf. Kane and Argote, 2005). As shown by the strong support for the faultline model, a shifting demarcation between subgroups is less likely than a stable demarcation between subgroups due to the power that characteristics of team composition have for shaping interaction patterns (Lau & Murnighan, 1998). For example, if Configuration 1 in Figure 3 emerged, then Members A and B are likely to be members of one identity-based subgroup throughout the life of the team while Members B and C are likely to be members of a different identity-based subgroup throughout the life of the team. The membership of these identity-based subgroups is unlikely to shift.

Once the demarcation between emergent subgroups is established for each subgroup type, there is another important consideration with respect to time: the three types of inter-subgroup processes can increase and decrease in importance during team engagement depending up on how the team's context and responsibilities change. One possibility is that one subgroup type may more important at a given time than the others. Consider an example of one project team. As norms are being established and before clarity on role responsibilities is attained, identity-based subgroups may predominate as

members interact with those who they feel most comfortable with socially. Knowledge-based subgroups may then predominate in the middle of the project as members interact almost exclusively according to technical expertise to design a product. Resource-based subgroups may then emerge to be increasingly important once the team has settled on two dominant alternatives for the product design, with two resource-based subgroups lobbying for opposing alternatives as an important team vote approaches. In the next section, we push further the idea that each subgroup type can affect different processes and outcomes. Later, we consider how multiple subgroup types may act in concert to impact the same team outcomes. This analysis will include a consideration of how team outcomes are affected by the extent to which the demarcation between subgroups of one type is aligned with the demarcation between subgroups of a different type.

The Relationship between the Configurational Properties of Subgroups and Subgroup Processes

As noted in the typology, each subgroup type is characterized by different processes. Indeed, whereas faultlines represent characteristics of team composition, subgroups are most appropriately conceptualized as active processes related to how distinct pockets of interdependent action emerge among members in work teams. Research on intergroup behavior has suggested that these processes can vary in intensity. For example, members in teams with identity-based subgroups can experience little identity threat or strong identity threat from other subgroups (Hogg & Terry), and teams can vary in the degree to which different knowledge-based subgroups clash with respect to their approaches to problem-solving (Nemeth, 1986). We suggest that the number of subgroups and variation in the size of subgroups are the key determinants of variation in

these subgroup processes. Although both of these configurational properties have been widely studied by teams scholars, they have not been integrated into a coherent framework, with scholars studying the number of subgroups separately from variation in the size of subgroups (Harrison & Klein, 2007; Harrison & Sin, 2005; Hartstone & Augoustinos, 1995; Kameda, Stasson, Davis, Parks, & Zimmerman, 1992; Kameda & Sugimori, 1995; Mannix, 1993; Menon & Phillips, 2010; O'Leary & Mortensen, 2010; Polzer, Mannix, & Neale, 1998; Polzer et al., 2006). Our theory of subgroups provides an opportunity to facilitate this integration.

Configurational properties highlight one of the key features of subgroup processes noted earlier: a subgroup is best understood not on its own, but in relation to other subgroups—that is, as a “set” of subgroups within a work team. Recall that this is the reason why we put forth theories of intergroup behavior as the theoretical lens for conceptualizing subgroups and inter-subgroup behavior. We suggest that subgroup processes vary systematically according to the number of subgroups and variation in the size of subgroups. As shown in Figure 1, considering how subgroup processes are affected by these two configurational properties further distinguishes the three subgroup types from one another.

There are several assumptions that guide the formulation of our arguments. Our analysis is relevant for teams with inter-subgroup behavior, hence our propositions are only relevant when there are two or more subgroups of a given subgroup type. Teams must have at least four members to have two or more subgroups. Additionally, teams—in which members are designed to work closely with one another—are rarely larger than twenty members, suggesting that the maximum number of subgroups in a team is about

ten and maximum variation in the size of subgroups exists when there is a subgroup of two members and a subgroup of about eighteen members. Our linear propositions for number and variability in size thus exist within the numerical constraints resident in teams of between four and twenty members. The relationships between the configurational properties of subgroups and subgroup processes are outlined in Figure 1. These relationships highlight that each subgroup type has both positive and negative effects, perhaps explaining why there is controversy as to whether subgroups are good or bad for teams (van Knippenberg & Schippers, 2007).

The Impact of Configurational Properties on Identity-based Subgroup Processes

The number of identity-based subgroups. As shown in Figure 1, an increasing number of subgroups has both positive and negative effects on identity-based subgroup processes. Both Hartstone and Augoustinos (1995) and Polzer et al. (2006) demonstrated that members view two interacting identity-based subgroups as being competitive and promoting an “us versus them” dynamic, whereas the presence of three subgroups promotes a more cooperative atmosphere, suggesting that an increasing number of subgroups lessens friction between subgroups. However, an increasing number of identity-based subgroups also creates more fractured, or fragmented, identities. This makes it difficult for members of different subgroups to establish shared social theories (Hogg, 2000).

Variation in the size of identity-based subgroups. As shown in Figure 1, increasing variation in the size of subgroups has positive effects on identity-based subgroup processes. When subgroups are equal in size, members from every subgroup

will feel threatened by a salient outgroup (Harrison & Kim, 2005). A work team with equal-sized subgroups is most likely to get “locked” in conflicts over issues related to values, ideologies, and beliefs (Phillips et al., 2004) and thwart opportunities to traverse the divides between subgroups because they perceive an “us vs. them” divide between subgroups (Harrison & Klein, 2007; Jehn & Bezrukova, 2010; Phillips et al., 2004). When variation is low, members of all subgroups perceive that outgroups assume a stronger presence because those outgroups literally loom larger (Harrison & Kim, 2005; Phillips et al., 2004). This reduces the extent to which it feels as if there is a broad, unified entity to which members belong. There is little possibility that shared social theories will emerge at the team level. Increasing variation in subgroup size reduces these negative effects.

The Impact of Configurational Properties on Resource-based Subgroup Processes

The number of resource-based subgroups. As shown in Figure 1, an increasing number of subgroups has both positive and negative effects on resource-based subgroup processes. Although no research has varied the number of resource-based subgroups in work teams, early investigations of networks within teams provide relevant insights. A hierarchy of multiple “chained” links softens the perception that there is a salient divide between those who have power and those who do not, whereas a single superordinate-subordinate divide leads subordinate members to perceive strong hierarchical stratifications (Leavitt, 1951). When there are less clear contrasts between the powerless and the powerful (as there is when there are more subgroups), it is less likely that members of subordinate subgroups will band together to try to redress the apparent

divides over resources and also less likely that members of dominant subgroups will band together to reinforce their dominance. In contrast to the positive effect that an increasing number of subgroups has on reducing the perception of hierarchical stratifications, there are drawbacks. In particular, the “chain-of-command” (i.e., the inbuilt power structure of the team) becomes longer and various subgroups are thus more likely to function as weakly connected nodes on an assembly line than as co-acting subgroups (Bunderson & Boumgarden, 2009; Garud & Kotha, 1994).

Variation in the size of resource-based subgroups. We interpret increasing variability in the size of resource-based subgroups to mean that resources are concentrated in an increasingly smaller subgroup at the expense of an increasingly larger subgroup. As shown in Figure 1, increasing variation in the size of subgroups has both positive and negative effects on resource-based subgroup processes. Sachdev and Bourhis (1991) conducted an experiment in which two subgroups faced off in a resource game in which the researchers varied status (high or low), power (dominant or subordinate), and subgroup size (majority subgroup or minority subgroup) in a full factorial design. Small subgroups (i.e., minorities) who possessed both power and status exhibited the maximum amount of discrimination possible, whereas subgroups in the other seven conditions exhibited moderate discrimination at most. Results of a social dilemma experiment by Mannix (1993) bolster the findings of Sachdev and Bourhis (1991): teams in which a small subgroup had a great degree of power and a large subgroup had little power involved the greatest amount of competition and retaliation between subgroups. Members of powerful subgroups actively sought to limit the number of members who belonged to their entitled subgroup. Whereas increasing variability of the size of subgroups promotes

inter-subgroup competition, there are positive influences on inter-subgroup processes: a team has a clearer, more centralized power structure. It is clearly defined as to which subgroup is dominant and which subgroup is subordinate, thus subgroups are able to work together more quickly and fluidly (Bunderson et al., 2010).

The Impact of Configurational Properties on Knowledge-based Subgroup Processes

The number of knowledge-based subgroups. As shown in Figure 1, an increasing number of subgroups has both positive and negative effects on knowledge-based subgroup processes. As qualitatively distinct knowledge-based inputs increase, threat rigidity may emerge when different subgroups interact, as members may be unable to integrate inputs into a coherent whole (Galbraith, 1974; Staw, Sandelands, & Dutton, 1981). As the number of knowledge-based subgroups increases, members pull away from the overwhelming number of inputs and spend more time in the enclave provided by his or her subgroup (Katz, 1982). Despite these dysfunctional processes, a greater number of unique viewpoints increases the pool of unique approaches to problem solving, fostering an innovative climate between subgroups (Jehn, Northcraft, & Neale, 1999; Polzer, Milton, & Swann, 2002; Williams & O'Reilly, 1998). Although there is a greater diversity of perspectives, individuals do not feel so different from other members that they have difficulty pooling ideas. Instead, members still have their own subgroups in which they can share information and take risks before creatively recombining of skills and abilities between subgroups (Gibson & Vermeulen, 2003).

Variation in the size of knowledge-based subgroups. As shown in Figure 1, increasing variation in the size of subgroups has both positive and negative effects on

knowledge-based subgroup processes. When variation in the size of subgroups is low, it becomes more difficult for members to process divergent sources of knowledge because the competition between ways of interpreting and acquiring knowledge becomes too extreme, and so different subgroups will not be able to easily integrate their outputs (Nemeth & Peterson, 1988). Whereas increasing variability in the size of subgroups increases shared mental models, it simultaneously increases the likelihood that minority viewpoints will be overshadowed or marginalized. Teams with equally-sized knowledge-based subgroups are least vulnerable to a dominant frame “taking over,” as members of each subgroup have enough clout to resist feeling compelled to honor a dominant subgroup framework (Janis, 1982). When members perceive that their approaches to problem-solving are better represented, they are also less likely to discard uniquely held information (Gigone & Hastie, 1993; Stasser & Titus, 1985).

Team-level Consequences of Subgroups

We now transition to considering the implications of our theory for team outcomes. See Figure 1. We examine outcomes at the *team* level of analysis because it is teams—and not subgroups—that are composed to execute tasks, such as designing products and providing services (cf. Kameda et al., 1992; O’Leary & Mortensen, 2010). Our typology is intended to be comprehensive as far as capturing the breadth of subgroup processes in teams. A consequence of this comprehensiveness is that the three subgroup types are likely to be related to more team outcomes than can be covered in a single analysis, given that there are dozens of critical team processes and outcomes (Cohen & Bailey, 1997; Gladstein, 1984; Hackman, 1987). We therefore hone in on just a few

illustrative outcomes based on key trends in the literature on intergroup behavior— however, we acknowledge that there are other outcomes likely to be affected by these subgroup processes, and it is also likely that some of these outcomes will be affected by more than one subgroup process at once (e.g., team trust can be affected by several pathways).

We first consider the ways that each subgroup type can affect team outcomes independently of the other two subgroup types. We then consider how the three types of subgroups can impact single team outcomes in combination.

The Unique Effects of Each Subgroup Type on Individual Team Outcomes

As noted in our analysis of the formation of subgroups, sometimes only one subgroup type will form in a team. Even when more than one subgroup type is present in a given team, each subgroup type is still likely to have unique effects. It is therefore important to first examine the individual effects of each subgroup type on specific outcomes. We build our propositions by assuming that scholars will test the configurational properties of subgroups in Figure 1 as the independent variables, the outcomes in Figure 1 as the dependent variables, and the subgroup processes identified in Figure 1 as mediating mechanisms. Thus, each proposition is built by considering two steps: the first step is the relationship in Figure 1 between a given configurational property and a subgroup process, and the second step is the relationship between that subgroup process and a given team outcome. For example, because an increasing number of identity-based subgroups is negatively related to perceptions of threat to subgroups' identities and perceptions of threat to subgroups' identities are negatively related to team

trust, there is a positive relationship between an increasing number of subgroups and increasing team trust.

The unique effects of identity-based subgroups. As shown in Figure 1, the two key processes of identity-based subgroups affected by configurational properties are identity threat (the increasing sense that there are strong “us versus them” divides) and identity fragmentation (the sense that a team does not have a coherent identity).

An example of an outcome that will be strongly affected by increasing “us vs. them” identity-based conflicts is team trust. The configuration of subgroups that promotes increased trust is likely to be one in which there are a large number of subgroups and large variation in the size of subgroups (see Figure 1). Both an increasing number of subgroups and increasing variation in the size of subgroups decrease identity threat because outgroups are not as salient and do not loom as large. When this occurs, members will be more willing to work in ways that exhibit trust, such accepting the vulnerability that comes with taking risks.

Proposition 1a: In teams with two or more identity-based subgroups, an increasing number of subgroups will increase team trust.

Proposition 1b: In teams with two or more subgroups, increasing variation in the size of subgroups will increase team trust.

An example of an outcome that will be strongly affected by the fracturing of a team’s identity is team cohesiveness. The configuration of subgroups that promotes team cohesiveness is likely to be one in which there is the fewest number of subgroups and the greatest variation in the size of subgroups (see Figure 1). Given that an increasing number of subgroups fractures a team into a larger number of fragments, it is more

difficult to build a coherent and cohesive identity. Thus a smaller number of subgroups is more optimal for cohesiveness. Increasing variation in the size of subgroups increases the presence of a dominant identity and promotes the greatest likelihood that one subgroup will assimilate into the other subgroup's identity.

Proposition 2a: In teams with two or more identity-based subgroups, an increasing number of subgroups decreases team cohesiveness.

Proposition 2b: In teams with two or more identity-based subgroups, increasing variation in the size of subgroups increases team cohesiveness.

The unique effects of resource-based subgroups. As shown in Figure 1, the two key processes of resource-based subgroups affected by configurational properties are perceptions of hierarchical stratifications between subgroups (the sense that there have vs. have-nots) and the clarity of the team's power structure (a clear hierarchical structure facilitates team operations).

An example of an outcome that will be strongly affected by increasing perceptions of hierarchical stratifications between subgroups is discrimination. The configuration of subgroups that maximizes discrimination is likely to be one in which there are few subgroups and large variation in the size of subgroups because this configuration enhances the perception that there are "haves" vs. "have nots." As the perception of stratification is enhanced, dominant subgroups feel threatened by disenfranchised subgroups and look to protect their resources by withholding them from the subordinate subgroups.

Proposition 3a: In teams with two or more resource-based subgroups, an increasing number of subgroups decreases discrimination.

Proposition 3b: In teams with two or more resource-based subgroups, increasing variation in the size of subgroups increases discrimination.

An example of an outcome that will be strongly affected by increasingly clear power structure is coordination costs. The configuration of subgroups that increases coordination costs is likely to be one in which there are many subgroups and little variation in the size of subgroups. As the number of subgroups increases, there is an elongated chain of command and therefore decisions cannot be made quickly or fluidly. As variation in the size of subgroups increases, centralization increases because a few members have the resources to exert power and control. Thus, processes are not weighed down by too many high-status and high-power “stars” (*Polzer Org Sci*).

Proposition 4a: In teams with two or more resource-based subgroups, an increasing number of subgroups increases coordination costs.

Proposition 4b: In teams with two or more resource-based subgroups, increasing variation in the size of subgroups decreases coordination costs.

The unique effects of knowledge-based subgroups. As shown in Figure 1, the two key processes of knowledge-based subgroups affected by configurational properties are the consideration of alternative sources of knowledge and convergence of “thought worlds.” An example of an outcome that will be strongly influenced as the consideration of alternative sources of knowledge increases is creativity. The configuration of subgroups that increases creativity is likely to be one in which there are many subgroups and there is little variation in the size of subgroups. As the number of subgroups increases, there is greater expertise to draw on and an increasing number of alternative ways of approaching a problem. Yet even though there is diversity in ideas, members do

not feel isolated from the team because they have safety in fellow subgroup members—they can take risks and perform trial-and-error with members of the same subgroup before knowledge is recombined between subgroups. As variation in the size of subgroups increases, the opinions of minority subgroups are more likely to be marginalized: large subgroups are less likely to incorporate ideas represented by smaller subgroups, and members of smaller subgroups are less likely to speak out because they lack clout (*Asch; Kanter*).

Proposition 5a: In teams with two or more knowledge-based subgroups, an increasing number of subgroups increases creativity.

Proposition 5b: In teams with two or more knowledge-based subgroups, increasing variation in the size of subgroups decreases creativity.

An example of an outcome that will be strongly affected by the convergence of “thought worlds” is the extent to which a team experiences shared mental models. The configuration of subgroups that increases shared mental models is likely to be one in which there are few subgroups and there is great variation in the size of subgroups. When there are fewer subgroups, there is more likely to be a common understanding that the team can draw from. Further, it is easier to develop cross-understanding because members have fewer alternate domains to attempt to understand (Huber & Lewis, 2010). When there is greater variation in the size of subgroups, teams can draw from dominant cognitive frameworks represented by the largest subgroups.

Proposition 6a: In teams with two or more knowledge-based subgroups, an increasing number of subgroups decreases shared mental models.

Proposition 6b: In teams with two or more knowledge-based subgroups, increasing variation in the size of subgroups increases shared mental models.

Combined Effects of the Three Subgroup Types on Individual Team Outcomes

Whereas we have studied the distinct effects of each subgroup type on single team outcomes, we outlined earlier how it is also possible that two or more subgroup types can simultaneously act on a single team outcome. In this section we use only one example—learning—to illustrate how single outcomes can be impacted by the configurational properties of multiple subgroup types. In the discussion we review other examples of single outcomes, including conflict and decision making, which can be impacted by multiple subgroup types at the same time. A number of scholars have employed subgroups in research related to team learning, including research on social and knowledge subgroups (Phillips et al., 2004), cohorts (Gibson & Vermeulen, 2003), and cross-understanding (Huber & Lewis, 2010). Perhaps the most compelling evidence linking subgroups and team learning comes from a field study by Gibson and Vermeulen (2003), who demonstrated that 12% of the variance in team learning was explained by their measure of subgroups. Further, learning is a good example of a broad outcome that is likely to be affected by a number of mechanisms at the same time. Team learning is defined as change in the “repertoire of potential behavior” (Wilson, Goodman, Cronin, 2007: 1044). We examine how this definition of learning is impacted by the configurational properties and the inter-subgroup processes depicted in Figure 1. There are two issues relevant when studying multiple subgroups at the same time.

The effect of an increasing number of subgroups or increasing variation in the size of subgroups on certain team outcomes may depend upon the type of subgroup. An examination of the effect of configurational properties of each subgroup type on learning illustrates that, by untangling the distinct mechanisms of the three subgroup types, our theory can resolve some unanswered questions in the literature on teams. For example, researchers have disagreed with respect to whether high variation in the size of subgroups in which numerical majorities and minorities exists is better (Harrison & Klein, 2007; Harrison & Sin, 2005; Jehn & Bezrukova, 2010; Menon & Phillips, 2010; Phillips et al., 2004) or worse (Asch, 1956; Gibson & Vermeulen, 2003; Gigone & Hastie, 1993; Janis, 1982; Mannix, 1993; O'Leary & Mortensen, 2010; Stasser & Titus, 1985) than when there is low variation in the size of subgroups and numerical majorities and minorities do not exist. Our theory suggests that variation in the size of subgroups can be both good and bad. Using learning as the dependent variable, we suggest that the utility of variation in the size of subgroups depends entirely upon the type of subgroup being studied.

Identity threat impairs the ability for a team to attain a climate of psychological safety, and therefore members feel comfortable enough to take risks and perform trial and error experimentation. Identity fragmentation is likely to impair common understanding and preempt the attainment of transactive memory—knowledge about where other team members' skills, abilities, and expertise reside. It will therefore be more difficult for the team to accumulate new behaviors because a the lack of a unified identity causes the actions of different subgroups to be loosely coupled as opposed to tightly coupled—decreasing the ability for members to assimilate new ideas within a coherent frame of reference. As shown in Figure 1, an increasing number of identity-based subgroups

reduces identity threat yet increases identity fragmentation, whereas increasing variation in the size of identity-based subgroups both reduces identity threat and identity fragmentation. Thus we make the following propositions:

Proposition 7a: An increasing number of identity-based subgroups has an inverted U-shaped curvilinear relationship with team learning.

Proposition 7b: Increasing variation in the size of identity-based subgroups is positively related to team learning.

Increasing perceptions of hierarchical stratification inhibit learning by preventing the flow of key resources throughout the team as perceived barriers between dominant and subordinate groups are inflated. Resources are more likely to be hoarded by dominant members, stagnating growth of disenfranchised members and reducing the overall behavioral potential of the team. An increasingly clear and streamlined power structure also inhibits learning. Although teams become more efficient as this occurs, it is precisely this ability to be efficient that works against the likelihood that new behavioral potential will develop because fewer members are likely to have access to valuable slack resources that promote learning (e.g., time for playfulness and experimentation, materials to use for trial-and-error, the ability to request feedback from supervisors). Although the efficiency wrought by a clearer power structure can help a team web together disparate ideas (thereby increasing learning), the predominant effect of an increasingly clear power structure on learning is likely to be negative because such a structure does not provide the munificence to empower a team to develop an increased behavioral repertoire (Hirst, van Knippenberg, Chen, & Sacramento, 2011). As shown in Figure 1, an increasing number of resource-based subgroups reduces perceptions of hierarchical stratification and reduces

the clarity of a team's power structure, while increasing variation in the size of resource-based subgroups increases perceptions of hierarchical stratifications and clarifies a team's power structure. Thus we make the following propositions:

Proposition 8a: An increasing number of resource-based subgroups is positively related to team learning.

Proposition 8b: Increasing variation in the size of resource-based subgroups is negatively related to team learning.

The consideration of alternative knowledge frames will promote learning because the number of possible behaviors in a team's repertoire will increase. Increasing convergence in thought worlds will also facilitate learning because it promotes the shared mental space that teams can use to integrate information and build coherent and sensible associations about new behaviors that can boost team processes and outcomes. As shown in Figure 1, an increasing number of knowledge-based subgroups increases the consideration of alternative knowledge frames while also preventing the convergence of thought worlds, and increasing variation in the size of knowledge-based subgroups reduces the consideration of alternative knowledge frames while promoting the convergence of thought worlds. Thus we make the following propositions:

Proposition 9a: An increasing number of knowledge-based subgroups has an inverted U-shaped curvilinear relationship with team learning.

Proposition 9b: Increasing variation in the size of knowledge-based subgroups has a curvilinear relationship with team learning.

A second issue relevant to the combined effects of multiple subgroup types is the extent to which the demarcations between subgroups are aligned. As discussed earlier,

Figure 3 illustrates one team in which the demarcation between subgroups for one type is aligned with the demarcation between subgroups of another type, and one case in which the demarcations are not aligned. We again use team learning to illustrate the impact of this type of alignment between subgroup types.

Gibson and Vermeulen (2003) suggested that moderate overlap between member traits is ideal because there is enough overlap to create knowledge-based subgroups that provide enclaves for subgroup learning, as well as the lack of overlap necessary to promote linkages between different subgroups. In this way, learning is facilitated when members polish ideas *within* subgroups and then integrate them *across* subgroups. We expand on this view by suggesting that different *types* of subgroups may simultaneously be leveraged to develop these cross-linkages. A close examination of their study provides evidence that there was indeed the presence of different types of subgroups: identity-based and knowledge-based. The authors related an example in which a five-member team had two knowledge-based subgroups: one three-member subgroup from production and one two-member subgroup from service. In this team, learning was promoted because two members from the same knowledge-based subgroup (production) shared an identity-based subgroup with one member from the other knowledge-based subgroup (service), and the remaining member from production was in an identity-based subgroup with the remaining member from service. The members of the same identity-based subgroups reported that sharing the same gender and age gave them shared identity, and that these bonds helped them traverse the demarcations between different knowledge-based subgroups. This example illustrates how team learning was enhanced when it occurred within knowledge-based subgroups but then could be integrated *between*

distinct knowledge-based subgroups because non-overlapping identity-based and knowledge-based subgroups provided cross-linkages. Thus, we suggest that it is not simply moderate overlap of *any* traits that will be beneficial (as scholars have argued), but instead moderate overlap between the traits that cause identity-based and knowledge-based subgroups.

Proposition 10: As the demarcation between identity-based subgroups becomes more aligned with the demarcation between knowledge-based subgroups, team learning will decrease.

Discussion

Over three decades ago, Leavitt (1975: 371) observed that “groups had not been taken seriously” in organizational scholarship. Although some groups, such as work teams, have been taken more seriously since Leavitt’s observation, we contend that *subgroups* now need to be taken more seriously. Although subgroups have been invoked in several literatures, including faultlines (Lau & Murnighan, 1998) and learning (Gibson & Vermeulen, 2003), the subgroup itself has not been a direct topic of theoretical inquiry. We have developed a theory of subgroups in which we have contended that there are three subgroup types with distinct substance, antecedents, consequences, and configurational properties. We now discuss the implications of our theory for the three literatures that were integrated into our model: intergroup behavior, team faultlines, and team diversity.

Implications for Research on Intergroup Behavior in Teams

Research on intergroup behavior is widespread at higher levels of analysis, such as between teams and between organizations. However, there has been little exploration of intergroup behavior *within* teams because of the lack of a fine-grained understanding of subgroups. Accordingly, scholars of intergroup behavior have not extensively examined inter-*subgroup* behavior in work teams. For any given study, researchers may be interested in only one subgroup type or have reason to believe, based on the factors related to faultlines and activation that were explored in the section on the relationship between faultlines and subgroups that only one subgroup type will exist. In these cases, researchers need only outcomes for that single subgroup type, and we presented some examples of these possible outcomes in propositions 1 – 6. In this way, the propositions outlined some possible independent effects of each subgroup type. Although only one form of inter-subgroup behavior may exist in a given team, one of the novel insights gleaned from our analysis is that more than one type of inter-subgroup behavior can be present within a given team. When more than one type of subgroup exists at the same time, there are two key considerations. After summarizing each consideration, we review the implications for literature on team learning (propositions 7 – 10) and then consider the implications for two other literatures that routinely invoke subgroups: conflict and decision making.

First, scholars should account for how different subgroup types react to the same configurational properties. As an example, we showed how our theory can show when low versus high variation in the size of subgroups is useful for learning. Yet the implications of our theory go beyond learning. For example, our theory can resolve the

debate over whether high variation in the size of subgroups is useful or harmful for relational conflict. It is likely that relational conflict increases as variation in the size of identity-based subgroups decreases while variation in the size of resource-based subgroups *increases*. High variation in the size of identity-based subgroups is helpful for relational conflict because such a configuration reduces identity conflict and identity fragmentation, whereas high variation in the size of resource-based subgroups is harmful for relational conflict because perceptions of hierarchical stratification increase.

As another example, our theory can resolve the debate over whether high variation in the size of subgroups is useful or harmful for team motivation in the context of decision making. It is likely that motivation increases as variation in the size of resource-based subgroups decreases while variation in the size of knowledge-based subgroups *increases*. High variation in the size of resource-based subgroups prevents most of the team from feeling empowered because they “share little of the wealth.” They are more likely to be disengaged during decision making. Alternatively, high variation in the size of knowledge-based subgroups provides a team with a dominant frame, suggesting that the majority of the team has a convergent mental model that will encourage more widespread buy-in.

An important consideration is the degree to which the demarcation between subgroups for one subgroup type is the same as the demarcation between subgroups for the other subgroup types. See Figure 3. As an example, we showed how our theory can show when low versus high variation in the size of subgroups is useful for learning. Now consider the controversy over whether task conflict is beneficial for work teams (De Dreu & Weingart, 2003). Although some scholars contend that task conflict has a positive

effect on teams and relational conflict tends to have a negative effect on teams (Jehn, 1995), it is thought that the two forms are often related so that the existence of relational conflict undermines task conflict (Simons & Peterson, 2000). Indeed, negative outcomes of task conflict can be mitigated when the relationship between task and relational conflict is low (De Dreu & Weingart, 2003). When viewed through a subgroup lens, task conflict is influenced primarily by knowledge-based subgroups because it is characterized by distinct approaches to solving task-based problems (Jehn, 1995). As noted previously, relational conflict is influenced by both identity-based and resource-based subgroups. When the demarcation between subgroups is the same for knowledge-based subgroups as either or both identity-based and resource-based subgroups, work team members may be unable to distinguish between divides over task-related matters and person-related matters because they are both represented by the same people. When the membership of identity-based and resource-based subgroups is not the same as the membership of knowledge-based subgroups, then members are better able to disentangle the different types of inter-subgroup behavior and leverage them for positive outcomes because they understand that task conflict operates independently of relational conflict. Accordingly, researchers of intergroup behavior who study inter-subgroup behavior in work teams should account for the extent to which the membership of identity-based and resource-based subgroups is identical to the membership of knowledge-based subgroups.

As another example, our theory can shed light on the power of minority influence in work teams. Although well-studied, the research on minority influence has received mixed support. Whereas some studies have not found numerical minorities to be especially influential, other studies have found that minorities exert influence that is

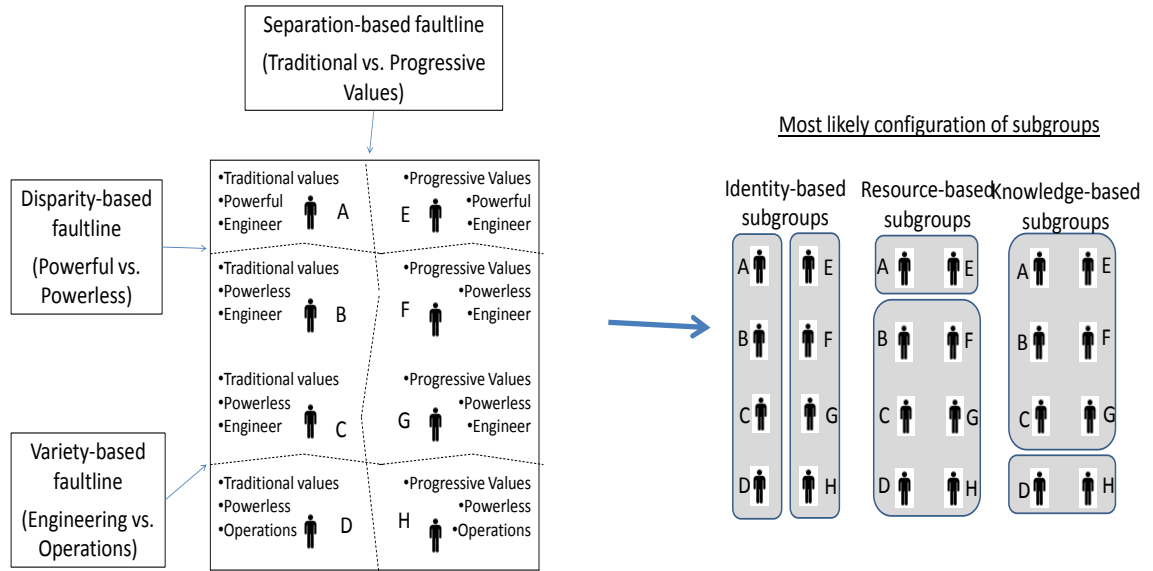
disproportionate to their numerical representation in the team when they possess knowledge that is distinct from the rest of the team. One important moderator of this effect has been consistency—the extent to which minorities do not waver when they express their beliefs. Another important moderator of this effect may be the degree to which there is alignment between resource-based and knowledge-based subgroups. It may not be sufficient for numerical minorities to merely possess different knowledge—they may also have to be in a position of power, control, or influence by being in a dominant subgroup.

Implications for Research on Team Faultlines

Our elaboration on the emergence of subgroups drew heavily from theory on faultlines (Homan et al., 2007; Lau & Murnighan, 1998; Li & Hambrick, 2005; Molleman, 2005; Pearsall et al., 2008; Sawyer et al., 2006). Research on faultlines has suggested that teams are ineffective when they possess strong alignment in which one subset of members share the same attributes (e.g., engineers who share the same cultural beliefs and full decision making power) while another subset of members share a distinct set of attributes (e.g., marketers who share a different set of cultural beliefs and who have no decision making power). Yet empirical research suggests that most teams possess imperfect, or *moderate*, faultlines—there is some overlap in traits, but not complete overlap. The samples of data that researchers have used to propose that moderate faultlines are good or bad usually appear to have diversity traits and process and contextual factors that would trigger all three types of subgroups at the same time, as exhibited by both teams in Figure 4 (Bezrukova et al., 2009; Choi, 2008; Earley &

Mosakowski, 2000; Gibson & Vermeulen, 2003; Lau & Murnighan, 2005; Li & Hambrick, 2005; Thatcher, Jehn, & Zanutto, 2003). Furthermore, there is debate with respect to whether teams are helped or hurt by moderate faultline strength (for a review of this controversy, see van Knippenberg & Schippers, 2007).

TEAM A



TEAM B

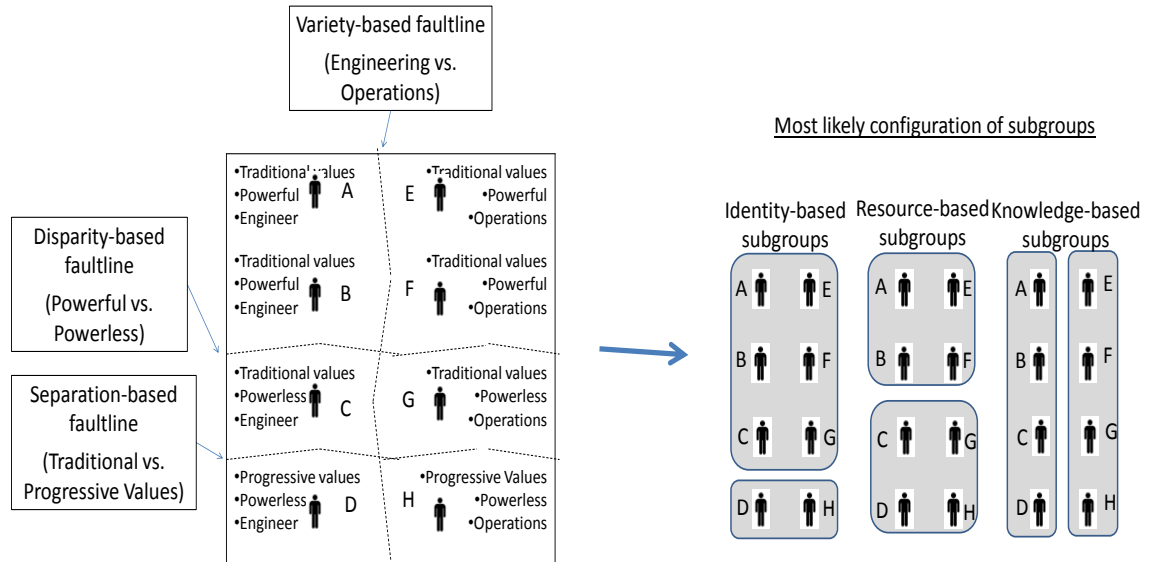


Figure 4: Examples of Two Teams with Different Configurations of Faultline Types and Subgroup Types

Our theory has the potential to resolve uncertainty surrounding the benefit of moderately strong faultlines. Given that the most well-studied outcome of faultlines is conflict (Lau & Murnighan, 1998; Li & Hambrick, 2005; Thatcher et al., 2003; Polzer et al., 2003; Choi & Sy, 1999), we draw on faultline theory as well as our analysis in the previous section on intergroup behavior to consider which team in Figure 4 has more beneficial forms of relational and task conflict. Both theory on faultlines (Lau & Murnighan, 1998) and measures of faultlines (Shaw, 2004; Bezrukova et al., 2004) would suggest that the teams in Figure 4 have the same faultline strength: there is little alignment between the three faultline types, but each faultline type has a single faultline for a total of three faultlines in each team. Given that both teams have similar alignment, theory on faultlines would suggest that conflict would be equally debilitating for both teams (Lau & Murnighan, 1998). Yet our theory would suggest that Team A is likely experience detrimental amounts of conflict, whereas Team B is likely experience beneficial amounts of conflict.

As shown in Figures 1 and 2, the most likely scenario for faultline activation for Teams A and B in Figure 4 is that the separation-based faultline will lead to identity-based subgroups, the disparity-based faultline will lead to resource-based subgroups, and the variety-based faultline will lead to knowledge-based subgroups, such that Team A-configuration 1 and Team B-configuration 1 will emerge. Team A-configuration 1 has low variability in the size of identity-based subgroups and high variability in the size of resource-based subgroups while Team 2 has high variability in the size of identity-based subgroups and low variability in the size of resource-based subgroups. Team A-configuration 1 will therefore have more relational conflict than Team B-configuration 1.

Given that both teams would benefit from task conflict because there is little alignment between members of knowledge-based subgroups and members of identity-based and resource-based subgroups (consistent with our arguments in the section on conflict), Team B-configuration 1 will benefit more from task conflict because the low variability in the size of knowledge-based subgroups will promote greater consideration of alternative perspectives. In short, Teams A and B have similar faultline strengths but will experience starkly different levels of success because Team B is likely to experience functional conflict and Team A is likely to experience dysfunctional conflict. This type of insight can only be surfaced if our theory of subgroups is incorporated into theory on faultlines.

Implications for Team Diversity

Diversity research examines how differences among members impact team outcomes. Whereas the faultline model provided initial theorizing with respect to when subgroup activity mediates diversity and team outcomes (i.e., when members align on different factors), there is currently no clear framework that can be used to understand how subgroups are created from the three different types of diversity identified in Harrison and Klein's (2007) reconceptualization of the diversity construct. We posit that faultlines located on each of the three types of diversity has a stronger relationship with one type of subgroup than the others.

Whereas theory on faultlines specifies whether the relationship between diversity and team outcomes will be mediated by subgroup activity—broadly defined—versus other interpersonal dynamics (e.g., isolation and withdrawal of individual members,

dominance by one member, unified action at the team level), our theory pinpoints the specific types of subgroup activity that are most likely to mediate diversity and team effectiveness. This can lead to novel predictions. For instance, whereas Harrison and Klein (2007) suggest that disparity has the most negative effect on teams when it is maximal (resources are concentrated in the hands of one member at the expense of the rest of a team), and theory on faultlines (Lau & Murnighan, 1998; Trezzini, 2008) suggests that disparity has the most negative interpersonal effects when it is moderate (resources are divided into two equal-sized subsets), our theory suggests that the most negative effects will occur when disparity is *between* moderate and maximum—when resources are concentrated in the hands of a minority at the expense of a majority. Assuming that disparity is triggered to form resource-based subgroups as opposed to identity-based subgroups, as we suggest is most likely to occur, this amount of disparity is likely to have a more negative impact on interpersonal dynamics than (1) maximum disparity because interpersonal relations are more strained when a hierarchy (dominant versus subordinate parties) is characterized by subgroups instead of individuals or combinations of subgroups and individuals (Insko, Schopler, Hoyle, Dardis, & Graetz, 1990), and (2) moderate disparity because discrimination is greater when the dominant subgroup is a numerical minority as opposed to the same size as the subordinate subgroup.

Another topic informed by our model is *cross-cutting diversity*, a concept that has recently grown in popularity in the diversity literature (e.g., Homan et al., 2007). Teams possess cross-cutting diversity when characteristics of members on one trait are not diagnostic of their characteristics on another trait (e.g., some, but not all, engineers are

females). Cross-cutting diversity exists in Configuration 1 in Figure 3 and does not exist in Configuration 2 in Figure 3. This type of pattern is beneficial because it prevents the alignment between members that yields faultlines. However, our theory would suggest that not all types of cross-cutting are equally effective, and instead cross-cutting should be configured to yield patterns of faultlines such as those in Team B in Figure 4 rather than those in Team A in Figure 4.

Managing Subgroups to Enhance Overall Team Effectiveness: The Role of Moderators

The tension between the positive and negative outcomes of subgroups suggests that subgroups alone are neither holistically bad nor good for team effectiveness, which is typically conceptualized as a combination of interpersonal and task-based attributes that relate to performance and member satisfaction. With the exception of the variability of the size of identity-based subgroups, both positive and negative outcomes are jointly promoted as the configurational properties of each of the subgroup types change. Thus, to understand how managers can “tip the balance” of subgroups to be more beneficial than detrimental, it is critical for scholars to identify moderating variables that accentuate the positive outcomes and inhibit the negative outcomes. It is likely that many moderators will impact only a limited number of the relationships identified in Figure 1.

For example, perhaps (1) a superordinate goal will override the tendency for a large number of balanced identity-based subgroups to promote the fractured identities that reduce team identification (Hornsey & Hogg); (2) the reduction in coordination costs achieved by a small number of imbalanced resource-based subgroups will depend upon the task, such that a creative team responsible for developing a new product will be less

positively impacted than a manufacturing team (McGrath); and (3) the lack of a shared team cognition created by a large number of balanced knowledge-based subgroups can be substituted by cross-understanding (Huber & Lewis) or by a team leader who engages in boundary spanning to translate the technical terminology used by different subgroups (Tushman & Scanlan, 1981). It is also important to understand how the factors of alignment and distance tested by faultline scholars may play important roles as moderators. As an example of distance as a moderator, there is likely to be greater discrimination exhibited when a dominant resource-based subgroup is compensated at a rate that is ten times greater than the subordinate subgroup versus two times greater. As an example of alignment as a moderator, the impact of identity-based subgroups is likely to be more negative in teams where there is a greater number of separation-based, disparity-based, and variety-based traits that reinforce the same subgroup membership, as members perceive a stronger divide between ingroups and outgroups.

Other factors may constrain the impact of configurational properties themselves. For example, the impact of the number and variability in size of subgroups on team effectiveness is likely to be influenced by the size of teams. Specifically, increasing team size allows for a greater number of subgroups and a lower balance of subgroups. For example, a team with fourteen members can have seven two-person subgroups of one type (a very large number), or can have one subgroup with two members and one subgroup with twelve members (very high variability in subgroup size). In contrast, a four-member team can only have two subgroups of any one type, and there cannot exist any variability in subgroup size (both subgroups must have two members). To the extent that the benefits from a large number of subgroups or high variability in subgroup size

offset the costs, teams should be designed to be larger. Another important element of team size is whether there is an odd or even number of team members. A team with an odd number of members and an even number of subgroups cannot have perfectly balanced subgroups. This will have meaningful consequences. For instance, a team with five members is unlikely to have extremely strong divides between two identity-based subgroups because the subgroups cannot be perfectly equal in size.

Future Extensions of the Theory of Subgroups in Work Teams

There are a number of factors that present opportunities to extend the basic tenets of our proposed model. Our model can help re-conceptualize other literatures related to critical team processes. Consider research on social networks. Several constructs included in our typology—cliques, clusters, status homophilies, and values homophilies—were drawn from literature on social networks (McPherson et al., 2001; Tichy et al., 1979). Most research on social networks in teams has studied either the *structure* of ties (i.e., which members communicate with whom) or the *content* of those ties (i.e., the substance or topic of the communication)—yet scholars have noted that structure and content are usually not studied in tandem and within a unified theory (Baldwin, Bedell, & Johnson, 1997; Borgatti & Foster, 2003). Given that structure equates to the number of subgroups and the variability in the size of subgroups (because these factors indicate the pattern of interactions) and content equates to the type of subgroup (identity-based, resource-based, or knowledge-based), the implications of our theory suggest that it is not only the case that structure and content can be studied together, but they *must* be studied together.

Another consideration is alternative linkages between faultlines and subgroup formation. One type of diversity can cause another type (differences in resources can

cause differences in knowledge), and thus one type of faultline can indirectly cause subgroups to form by causing a different faultline (e.g., variety-based faultlines can cause disparity-based faultlines, which then cause resource-based subgroups). See Harrison and Klein (2007) for an elaboration on the relationships between different types of diversity.

Conclusion

Accumulating evidence suggests that the importance of subgroups in work teams exceeds the volume of research devoted to studying them directly. We presented a theory that included a typology of subgroups and a model of the antecedents and outcomes of subgroups in work teams. In discussing the implications of our theory for a number of literatures, it is our hope that scholars will continue to move the subgroup to the foreground in research on work teams.

CHAPTER 2: A MEASURE OF SUBGROUPS IN WORK TEAMS

As organizations have increasingly turned to work teams to accomplish objectives, subgroups have become an important determinant of team effectiveness. Research on subgroups has recently become more popular with the advent of the faultline model, in which Lau and Murnighan (1998) suggested that subgroups are likely to form when some members share common traits and others do not. For example, two members of a four-member team might be Hispanic females in their mid-40's, while two other members might be Black males in their mid-20s, yielding faultlines based on the alignment of gender, ethnicity, and age. Extensive research on the faultline model has demonstrated the impact of subgroups on outcomes such as performance, conflict, and trust (Bezrukova, Jehn, Zanutto, & Thatcher, 2009; Choi & Sy, 2009; Chrobot-Mason, Ruderman, Weber, & Ernst, 2009; Earley & Mosakowski, 2000; Homan et al., 2008; Homan, van Knippenberg, Van Kleef, & De Dreu, 2007a, b; Lau & Murnighan, 1998; Lau & Murnighan, 2005; Li & Hambrick, 2005; Molleman, 2005; Pearsall, Ellis, & Evans, 2008; Rico, Molleman, Sanchez-Manzanares, & Van der Vegt, 2007; Sawyer, Houlette, & Yeagley, 2006; Shaw, 2004). Furthermore, research on work teams that has extended or departed from research on faultlines has also provided strong evidence on the importance of subgroups in work teams for outcomes such as decision making and team satisfaction (Cramton & Hinds, 2005; Gibson & Vermeulen, 2003; Hornsey & Hogg, 2000; Huo, Smith, Tyler, & Lind, 1996; Kameda, Stasson, Davis, Parks, & Zimmerman, 1992; Mamali & Paun, 1982; O'Leary & Mortensen, 2009; Park, Ryan, & Judd, 1992; Polzer, Crisp, Jarvenpaa, & Kim, 2006; van Knippenberg, De Dreu, & Homan, 2004).

Given that the importance of subgroups is well-established, it is surprising that no measures currently exist to assess subgroups directly. A few existing measures approximate the degree to which subgroups are *likely* to form based on the alignment of member traits (Gibson & Vermeulen, 2003; Shaw, 2004). When researchers have studied subgroups, they have used research designs to constrain factors related to subgroups themselves, such as the number of subgroups, the size of subgroups, the membership of subgroups, and the proportion of members that belong to subgroups (Lau & Murnighan, 2005; O'Leary & Mortensen, 2009; Polzer et al., 2006; Thatcher, Jehn, & Zanutto, 2003). Thus, measures that do not assess subgroups directly or research designs that put heavy constraints on subgroups provide barriers to capturing subgroup dynamics as they exist “in the wild” in work teams and organizations.

To address the need for a direct measure of subgroups, we introduce and test a *subgroup algorithm*. A direct measure of subgroups provides several new opportunities for researchers of faultlines and other topics that we argue are relevant to subgroups, such as conflict and team leadership. For example, a subgroup algorithm can help researchers more clearly see the subgroup dynamics that mediate the relationship between faultlines and team outcomes. Instead of identifying the mere existence of general “hot spots” of potential subgroup formation, it can pinpoint the precise location of the divides between subgroups. This algorithm is unique because it focuses on a level of analysis (the subgroup) that has remained relatively unexplored in the workplace, and captures dynamics that are within a work team but beyond the individual level of analysis. Ultimately, the algorithm can serve as a bridge between the individual → subgroup → team levels of analysis by highlighting the membership of the subgroups themselves. In

this way, our investigation of a new level of analysis also allows for interesting cross-level applications—such as the three-way interaction between subgroups, members of subgroups, and work teams. Finally, a subgroup algorithm can push beyond being a novel and timely methodological advance by also advancing theory on work teams. The algorithm can help researchers see elements of theoretical import that have thus far remained hidden—such as the degree to which leaders (or other members) serve as connecting links between subgroups. This can trigger new and unexpected research questions related to the impact of subgroups on work team effectiveness.

Given the popularity of the team faultline concept and the fact that it has resulted in the largest number of existing measures of subgroups, we use existing measures of faultlines as the benchmark against which a new measure at the subgroup level of analysis should be judged. As such, there are several criteria that a subgroup algorithm should meet: First, in staying true to the methodological advances that have been made over the last decade in research on faultlines, it should have a clear relationship to the dominant team-level measures (Shaw, 2004; Thatcher et al., 2003). A second, related criteria, is that it yields measures that can be aggregated to the team level. Third, it should provide alternative insights and conclusions from existing faultline measures. For example, can the measure cross levels of analysis by identifying the position of specific members in specific subgroups (a bridge between individual and subgroup level of analysis) and the number of subgroups in a team (bridge between subgroup and team level of analysis)? Fifth, from a practical perspective, the assumptions of the model should be as clear and straightforward as possible so that team researchers are likely to adopt it.

Review of Existing Measures

Existing measures of faultlines have largely approximated the formation of subgroups in work teams instead of measuring their properties directly. Shaw's (2004) measure is perhaps the most loyal to the original conceptualization of faultlines provided by Lau and Murnighan (1998) because it assesses the degree to which a team has some members who are aligned on traits and other members who are not aligned on those same traits. Similarly, Gibson and Vermeulen (2003) measured how much trait overlap there was between all dyads on each team, and then took the standard deviation of this value to assess the degree to which trait overlap was concentrated among some members and not others.

Other measures have made slight departures from the theoretical premise of faultlines to move closer to measuring subgroups themselves. Thatcher, Jehn, and Zanutto (2003) introduced a measure that assesses the variance within and between subgroups for every possible condition in which there are two subgroups on a team. Li and Hambrick (2005) used a modified version of the d-statistic to capture the extent to which two subgroups in a work team (1) have different average values on a characteristic (e.g., age, tenure, gender, and ethnicity) and (2) where each subgroup had members who were tightly clustered (e.g., each subgroup had small standard deviations). Trezzini (2008) tested a measure that assessed the degree to which team members are bipolarized (thus creating conditions for two equal-sized subgroups). He also contended that greater faultline strengths yield subgroups that are (a) formed on many traits, (b) have a great distance between them, (c) and are fewer in number. Recently, Bezrukova et al. (2009) introduced a measure that captured the distance between subgroups by assessing the

variance decomposition of every possible two-subgroup split on the team. Similar to the Thatcher, Jehn, and Zanutto (2003) measure, their measure was only used for the strongest two-subgroup split (i.e., other configurations of subgroups, such as three subgroups, were not considered).

In conclusion, even existing measures that have focused on subgroups themselves have left important aspects of subgroup variables hidden (e.g., the number of subgroups in a team). However, the lack of an approach that more deeply explores subgroups does not justify that one should exist. Accordingly, we next motivate the need for such a measure.

The Need for an Expanded Measure of Subgroups in Work Teams

Why is a more extensive measure of subgroups needed? Consider two attributes of subgroups that are likely to be important, yet are not considered by current measures of faultlines. First, the number of subgroups on a team, or *subgroup count*. Recent evidence has suggested that there are likely to be different types of subgroups—subgroups based on identity and subgroups based on knowledge (Choi & Sy, 2009; Phillips, Mannix, Neale, & Gruenfeld, 2004; Sawyer et al., 2006). It is likely that subgroups based on identity will have more pronounced effects on team outcomes, such as satisfaction, when there are only two subgroups because experimental research has suggested that a two subgroup count engenders a greater “us vs. them” competitive dynamic (Hartstone & Augoustinos, 1995; Polzer et al., 2006). However, an information processing perspective would suggest that subgroups based on knowledge will have more pronounced effects on team outcomes, such as performance, as there are increasingly *more* subgroups on the team (Hinsz, Tindale, & Vollrath, 1997). A greater number of subgroups results in more

inputs that must be coordinated and assimilated—a phenomenon that can lead to overload. Second, consider evidence from Harrison and Klein (2007), who argued that coalitions (a type of subgroup) on teams are likely to be strongest when key resources are concentrated in the hands of few (a small subgroup) at the expense of many members with access to few resources (a large subgroup). This suggests that the *imbalance* of one subgroup relative to another is highly important. O’Leary and Mortensen (2009) provided further evidence supporting the importance of imbalance when they demonstrated in a quasi-experiment that members of the minority subgroup are harmed when an advantaged subgroup is large.

Consider Table 2. In both Team A and Team B, faultlines are moderate because the distinct attributes (race and function) are not highly correlated. Yet the implications for team effectiveness are likely very different. In the first team, there are two identity-based subgroups and four knowledge-based subgroups—suggesting that both types of subgroups have counts that are detrimental to team functioning. The opposite is true in Team B: both subgroups have counts that are unlikely to harm team functioning. Thus, even though both teams have the *same faultline strength*, the number of the different types of subgroups is likely to predict significant variance above and beyond faultlines. Yet existing measures do not capture these attributes for teams in the field. Instead, evidence only exists from the experimental and quasi-experimental research reviewed above, and these studies only manipulate a narrow slice of the possible subgroup configurations in real work teams. Consequently, we suggest that a new approach is needed to tap into the construct of the subgroup itself, in which factors such as count and

imbalance can be captured in the numerous configurations of subgroups that are likely to be found in field settings.

Table 2: Overlap in Membership between Two Types of Subgroups

Team A

Member	Identity-based Subgroups	Knowledge-based Subgroups
A	White	Customer Service
B	White	Customer Service
C	White	Engineering
D	White	Engineering
E	Asian	Operations
F	Asian	Operations
G	Asian	Marketing
H	Asian	Marketing

Team B

Member	Identity-based Subgroups	Knowledge-based Subgroups
A	White	Engineering
B	White	Engineering
C	Asian	Engineering
D	Asian	Engineering
E	Black	Marketing
F	Black	Marketing
G	Native American	Marketing
H	Native American	Marketing

Note. Attributes taken from Lau and Murnighan (1998).

Toward a Measure of Subgroups

There are several parameters that governed our development of a measure of subgroups within work teams. First, given that subgroups are characterized by processes such as mutual influence and interdependence, it should be flexible to account for process factors such as communication and interaction—something that faultline measures have not done. Second, it should involve consistent membership, where each member can only belong to one subgroup in a given context. This provides a number of useful advantages for cross-level analyses. For example, one can identify which subgroup, if any, includes a team leader. Third, a measure of subgroups should not demand that every member of a team be in a subgroup (i.e., isolates are permitted). If a subgroup is a set of members that has greater group-like qualities than the rest of the team, then it should not guarantee that all members (or any members) will be in a subgroup. Although subgroup formation is certainly prone to occur due to grouping and categorization processes that lead members to gravitate toward one another, there are cases when there are isolates on a team. Indeed, an isolate is a qualitatively distinct entity from a subgroup (O'Leary & Mortensen, 2009). Thus, it is important to create a “threshold” of shared attributes and shared process factors that a set of members would have to be *above* in order to be considered a subgroup.

Fourth, as reviewed earlier it is likely that there are at least two types of subgroups in work teams (identity-based and knowledge-based). Thus, attributes that relate to these different mechanisms should be considered to cause different subgroups as opposed to the same subgroups. However, attributes that are similar and represent the

same subgroup type (e.g., beliefs and values contribute to identity-based subgroups) should be grouped together because they will capture whether membership in a particular subgroup is reinforced. Fifth, count and imbalance should not be “fixed” in work teams. Prior measures of faultlines have not accounted for the impact of count and imbalance outside of experimental or quasi-experimental designs. If these characteristics are allowed to vary as they exist in their natural state, then there will be an opportunity to examine their impact on team process and outcomes in field settings.

Given these five parameters, we depart from existing measures of faultlines. However, we note when we adapt ideas from existing measures. In this way, our measure is presented more as an extension of existing measures than a strict departure from them. We first describe our subgroup algorithm, and then explain how the algorithm is similar to and different from existing measures reviewed above.

The Subgroup Algorithm

Our objective is to determine which configuration of subgroups on a team is most representative of the actual subgroup dynamics in the context in which the team worked. We define “configuration” as the arrangement of members across *exclusive* subgroups for a given attribute. For example, a three-member work team may have one subgroup based on the attribute of gender that is either composed of members A and B or members B and C—but it cannot have both configurations. In developing an algorithm that determines the best subgroup configuration in a work team, several steps are required.

Researchers must first decide, based on the theoretical questions of interest, which attributes to explore (e.g., functional expertise and communication). Subgroups based on processes, such as communication, are relevant when it is the emergent norms of

communication and interaction—patterned emergence—that are of greatest interest to researchers (Roberson & Colquitt, 2005). All else equal, it is better to have more attributes because it allows for a more accurate impression about which team members truly do share subgroup membership versus those who do not (Trezza, 2008). For example, if only one attribute were chosen (e.g., beliefs), members A and B may share a subgroup and members C and D may share a subgroup. However, if two other attributes are also chosen in addition to beliefs (e.g., gender and race), then they may reveal that A and D are in the same subgroup and B and C are in the same subgroup—a finding that contrasts with what is found when only beliefs are used as an attribute. Thus, an algorithm that includes all three attributes (beliefs, gender, and race) will suggest that the most important subgroup configuration is that which is between A-D and B-C. In short, greater accuracy is achieved with more attributes.

Researchers should also be cautious to recognize when some attributes may form entirely different types of subgroups than other attributes. Consider two variables—beliefs and function. It may be the case that each attribute reflects a *different* type of subgroup instead of the same subgroup. Perhaps beliefs reflect subgroups that are based on identity and function represents subgroups that are based on knowledge. Thus, to be as conservative and careful as possible, researchers should be highly attuned to the context that they are studying in order to determine (1) how many types of subgroups they are interested in measuring and (2) which attributes reflect those subgroups.

We adhere to the assumption of the faultline model that subgroups form from fixed traits. Teams have many possible configurations of subgroups. All of the possible subgroup configurations for a team of 4 members are included in the following example,

whereby brackets indicate the entire configuration [A-B, C-D]; parentheses and hyphens indicate which subset of members is going to be tested to determine if they are a subgroup, such as when A and B are in the same subgroup A-B; and commas (,) indicate divides between subgroups, such that a comma demarcates subsets A-B and C-D in the configuration [A-B , C-D]:

Possible subgroup configurations for a four person team (members A, B, C, and D):

- *A subgroup of size 3 and an isolated member* – [A-B-C , D] or [A-B-D , C] or [A-C-D , C] or [B-C-D , A]
- *2 subgroups of size 2* – [A-B , C-D] or [A-C , B-D] or [A-D , B-C]
- *A subgroup of size 2 and 2 isolated members* - [A-B , C , D] or [A-C , B , D] or [A-D , B , C] or [B-C , A , D] or [B-D , A , C] or [C-D , A , B]

In this analysis, and in line with all existing research on subgroups, we are interested in identifying which of these subgroup configurations is characterized by the *greatest amount of similarity within subgroups and the greatest amount of dissimilarity between subgroups*. In order to make these calculations, we first had to assess every dyad in the team given that the dyad is the basis of all relationships and is the best way to extrapolate the nature of every subgroup configuration on a team (Gibson & Vermeulen, 2003). To calculate dyad overlap, we followed this basic formula:

$$\frac{[(\text{Top of variable's range} - \text{Bottom of variable's range}) - (\text{Member A's value} - \text{Member B's value})]}{(\text{Top of variable's range} - \text{Bottom of variable's range})}$$

For categorical variables, the value will be either 0 or 1 since a member either belongs to the same category as another member or a different one. Once the overlap of every dyad was determined, we could assess every configuration of subgroups on each team (e.g., all 115,973 subgroup configurations on a ten-member team). If a configuration included subgroups with two members, then the dyad score for that subgroup would be used. If the configuration included subgroups with three members, then the three dyad scores between the three members would be averaged. If the subgroup had four members, then the six dyad scores between the four members would be averaged, and so on.

The next step was to determine what constitutes a set of members belonging to the “same” subgroup. The first decision relates to how many traits members should share in order to deem that they are in the same subgroup. This is a decision that researchers should make based on context. In an example in which there are 4 categorical traits, perhaps a researcher decides that members must share at least 3 of the 4 traits to be in the same subgroup. The threshold can then be calculated from this value: if members must share at least 3 of 4 traits to a part of the same subgroup, then they must share more than 74% of the traits. A threshold value can therefore be .74. We acknowledge that it is hard to be precise about a threshold given the complex nature of trait distributions, hence for all results sensitivity analyses should be conducted using threshold values that departed from the ones used for the primary analyses.

For any configuration of subgroups, the average dyad score *within* a given subset of members (e.g., members A, B, and C) must surpass the threshold value in order for the members in that configuration to be considered part of the same subgroup, and the

average dyad score *between* different subsets must be below the threshold value. Using this basic formula, the algorithm runs a series of iterations in order to identify the configuration of subgroups in which there is *the weakest overlap between each subset of members*. The final configuration of subgroups on a team therefore meets three criteria:

1. The average dyad score of the members within each subgroup is above the threshold value.
2. The average dyad score of the members between each subgroup is below the threshold value.
3. There are no other configurations of subgroups in which the average dyad score of the members between each subgroup is lower.

The configuration of subgroups with the greatest between-subgroup difference in average dyad scores is chosen as a given team's *dominant subgroup configuration*. If differences between subgroup configurations are not great enough (the average dyad scores are all above the threshold) or too great (the average dyad scores are all below the threshold), then the team is considered to have no subgroups.

The algorithm has a constraint that allows it to specify that only subgroups, and not isolates, can exist. In this case, only 2 subgroups of size two can exist. This makes the algorithm more flexible if researchers assume that members always gravitate toward subgroups because of the strong evidence that organizational members prefer to have some subgroup attachment (Hogg & Terry, 2000). Regardless of whether isolated members are considered, the remainder of the algorithm is calculated the same way.

Consider an example. A team of 4 members [A, B, C, D] is to be measured according to 4 attributes (City, Business Unit, Gender, and Marital Status). Members

must share at least 3 of 4 traits, so the threshold value is .74. Here are the attributes of each member:

Member A: New York, BU 13, Male, Single

Member B: New York, BU 14, Male, Single

Member C: San Francisco, BU 12, Male, Married

Member D: San Francisco, BU 12, Female, Married

One of the possible subgroup configurations is A-B, C-D. To make calculations for this subgroup configuration, dyad scores are not initially generated for dyads “within” a subgroup: A-B, C-D. At first, only dyad scores between subgroups are calculated. Thus, in the example below only 4 of the 6 possible dyad scores are used in the calculation: A-C, A-D, B-C, and B-D (boldfaced below). We will return later to how the algorithm accounts for the dyad scores within subgroups. The dyads are scaled to a value between 0 and 1 by dividing by the total number of attributes they share by the total possible attributes that can be shared—4 in this case.

$$A-B: 3 / 4 = .75$$

$$**A-C: 1 / 4 = .25**$$

$$**A-D: 0 / 4 = 0**$$

$$**B-C: 1 / 4 = .25**$$

$$**B-D: 0 / 4 = 0**$$

$$C-D: 3 / 4 = .75$$

When summing the dyad scores and dividing by the number of dyads (4), we get the average between-subgroup score for that configuration. The average between-

subgroup score = $.25 + 0 + .25 + 0 / 4 = .125$. Suppose that $.125$ is the lowest score of all configurations on the team. This would mean that there is less overlap between members of different subgroups for this configuration than any of the other configurations. In this case, the configuration of A-B, C-D would be the dominant subgroup configuration because it signals that there are greater differences in this configuration than any other configuration between (1) distinct isolates, (2) subgroups and isolates, and (3) distinct subgroups.

One more decision needs to be made at this step: Whether the team has any subgroups at all. As noted above, in order for this subgroup configuration to be formally chosen, two requirements must be met. First, the overlap between members of different subgroups must be below the threshold value, which is $.74$ in this example. If it is, then it would indicate that the differences are not only relatively larger than in other configurations, but large enough in an *absolute* sense. Since $.125$ is below $.74$, this requirement is met. Second, the average similarities within subgroups must be *above* the threshold value of $.74$. This value is $(.75 + .75) / 2 = .75$. This value is above the threshold, and thus this configuration of subgroups as the dominant configuration is confirmed.

Finally, any measures related to subgroups can be calculated based on the researchers' interests. Consider team level measures in the case of the team in which A-B, C-D is the best configuration. Various measures can be calculated. Three examples are *number of subgroups* (there are two subgroups), *subgroup size* (the average subgroup size is 2 members), and *subgroup balance* (the standard deviation of subgroup sizes is 0, suggesting that the team has "perfectly" balanced subgroups).

Comparison between the Subgroup Algorithm and Existing Faultline Measures

The subgroup algorithm can and should be compared against existing faultline measures. We make three comparisons that reflect both the nuances and the breadth of the measure. Each existing faultline measure lends something unique to the picture of subgroups. Our model also adapts and modifies certain elements from each of these existing measures. Thus, as mentioned earlier, we do not present our algorithm as a departure of existing measures, but rather an extension of them.

The Subgroup Algorithm Compared to the Subgroup Strength Measure

Gibson and Vermeulen (2003) used a proxy to assess the potential for subgroups to develop: the variation in overlap between dyads. In teams in which some dyads shared multiple characteristics, and other dyads did not, there was the likelihood that subgroups may form. We have adapted the notion of dyad overlap as a building block on which to measure subgroup development. We agree that assessing the dyad level of analysis is a straightforward way to understand the degree to which a team is characterized by areas in which some members may share multiple traits while others do not. However, instead of the dyad being the *final* level of analysis through which a team's subgroups can be assessed, we use the dyad as a basic level of analysis from which information at the focal level of analysis—the subgroup level—can be extrapolated.

A consideration of the configuration of subgroups, as opposed to dyads, yields insights about how the *configuration* of subgroups on a team (e.g., the number and size of subgroups) impacts team effectiveness. Consider a four-member team. Gibson's and Vermuelen's (2003) measure would assess the variation in overlap of the six dyads on the team (A-B, A-C, A-D, B-C, B-D, and C-D). In the subgroup algorithm, a four-member

team may indeed have two-member subgroups—but it may also have no subgroups (A-B-C-D) or three-member subgroup coupled with isolates (e.g., A-B-C vs. D or A-C-D vs. B). We address the possibility of no subgroups by assessing whether all four members have so much in common that the team is not characterized by subgroups. We then address the possibility that a configuration involving a three-member subgroup and one isolate may be “stronger” than that in which there are two two-member subgroups because the distance between three members and an isolate might be greater.

Example. The subgroup algorithm and its ability to aggregate information at the dyad level of analysis to information at the subgroup level of analysis leads to some conclusions that may be discrepant from those yielded by Gibson’s and Vermeulen’s (2003) measure of subgroup strength. Consider two teams measured on the traits of beliefs, values, personality, and gender. First is a four-member team in which there is a strong three-member subgroup (three members who share the same four traits) and one isolated member (who does not share any traits with the other three members). If three of the six dyads have complete overlap (4 traits) and three of the six dyads have no trait overlap (0 traits), then the standard deviation of dyad overlap is 2.19. Gibson and Vermeulen (2003) consider this standard deviation to be the magnitude of subgroup strength. In contrast, in a four member team in which members A and B have complete overlap (4 traits) and members C and D have complete overlap (4 traits), there would be a lower subgroup strength score (the standard deviation of dyad overlap would be 2.07). Yet much evidence suggests that teams with two evenly sized subgroups based on the characteristics of beliefs, values, personality, and gender would have stronger effects at the team level than a team with one subgroup (Harrison & Klein, 2007; Harrison & Sin,

2005; Hartstone & Augoustinos, 1995; Polzer et al., 2006). This example demonstrates how the identification of the *configuration* of subgroups on a team is an important advantage of the subgroup algorithm. The configuration of subgroups perhaps becomes even more important as team size increases and the number of possible configurations grows. Table 3 demonstrates how the gap between the number of dyads on a team and the number of potential subgroups on a team grows exponentially as team size increases.

Table 3: Comparison of Robustness of Subgroup Algorithm with Subgroup Strength Measure and *Fau* Measure

Team Size (number of members)	Number of Dyads in Subgroup Strength Measure (Gibson & Vermeulen, 2003)	Number of two- subgroup splits in <i>Fau</i> Measure (Thatcher et al., 2003)	Number of Subgroup Configurations in Subgroup Algorithm
3	3	0	3
4	6	7	13
5	10	15	50
6	15	31	201
7	21	63	875
8	28	127	4,138
9	36	255	21,145
10	45	512	115,973

The Subgroup Algorithm Compared to the *Fau* Measure

Thatcher, Jehn, and Zanutto (2003) took an approach to measuring subgroups that was not based on dyad overlap, but instead was motivated by multivariate statistical cluster analysis. The authors constrained the number of possible subgroups on a team to two. They measured every possible two-subgroup split, and chose the two-subgroup split in which subgroups were most distinct on the attributes of focus (e.g., age, gender, and race). The subgroup algorithm is similar to this approach because it chooses the configuration of subgroups with the greatest distance between them. However, there are

important differences between the subgroup algorithm and the *Fau* measure. First, the subgroup algorithm does not always split a team into subgroups. Instead, it requires that there be some minimum threshold of difference between potential subgroups. Second, it relaxes the constraint of two subgroups, which is an important limitation of the Thatcher et al. (2003) measure. As shown in Table 3, the gap between the number of configurations existent when the two-subgroup constraint is removed versus when it exists increases exponentially as team size increases. As noted earlier, we suggest that subgroup count is extremely important for understanding the impact of subgroups on work teams.

Example. We focus on comparing the subgroup algorithm with the *Fau* measure (Thatcher, Jehn, and Zanutto, 2003). Table 4 adapts data from Shaw (2004—shown in the Appendix), as an example of subgroup configurations when faultline strength is low, medium, and high. The example uses the attributes that were used by Lau and Murnighan (1998): gender (two levels coded male = 1 or female = 2), age (four levels coded 20s = 1, 30s = 2, 40s = 3, 50s or older = 4), race (four levels coded White = 1, Black = 2, Asian = 3, Native American = 4), and job (four levels coded plant manager = 1, human resources manager = 2, clerical staff = 3, unskilled = 4).

Table 4: Comparison of Subgroup Algorithm with *Fau* Measure

	<u>Team ID</u>	<u>Team Size</u>	<u>Subgroup Algorithm</u>		<u>Fau</u>	
			Number of subgroups	Configuration	Number of subgroups	Configuration
Low faultline propensity teams			3	(A) - (C) - (B,D)	2	(A,B) - (C,D)
			3	(B,C) - (A) -(D)	2	(A,D) - (B,C)
			4	(A) - (B) -(D) - (C,E)	2	(A,E) - (A,C,D)
			3	(B) - (C) - (A,D)	2	(A,D) - (B,C)
			1	(A,B,C,D)	2	(A) - (B,C,D)
			1	(A,B,C,D,E)	2	(D,E) -(A,B,C)
Medium faultline propensity teams			3	(A) - (B) - (C,D)	2	(B) - (A,C,D)
			4	(B,F) - (E) - (A) - (C,D)	2	(A,C,D) - (B,E,F)
			2	(A) - (B,C,D,E,F)	2	(A) - (B,C,D,E,F)
	0		5	(D) - (G) - (A,C) - (F) - (B,E)	2	(B,E) - (A,C,D,F,G)
	1		1	(A,B,C,D,E)	2	(D,E) - (A,B,C)
	2		2	(D) - (A,B,C,E,F,G,H)	2	(A,E) - (B,C,D,F,G,H)
High faultline propensity teams	3		3	(C,D) - (A) - (B)	2	(A,B) - (C,D)
	4		3	(A,D,H) - (C) - (B,E,F,G)	2	(A,D,H) - (B,C,E,F,G)
	5		2	(A,B) - (C,D)	2	(A,B) - (C,D)
	6		2	(A,B) - (C,D,E)	2	(A,B) - (C,D,E)
	7		2	(A,B,E) - (C,D,F)	2	(A,B,E) - (C,D,F)
	8		2	(C,D,G) - (A,B,E,F)	2	(C,D,G) - (A,B,E,F)

Table 4 (cont'd): Comparison of Subgroup Algorithm with *Fau* Measure

Note. Shaded cells indicate convergence between the Subgroup Algorithm and *Fau*. Team ID (1,2,3...) and Configuration column letters (A, B, C...) correspond with teams and members, respectively, in the Appendix (adapted from Table 2 in Shaw, 2004). When the subgroup algorithm and the *Fau* measure are used on the same data, few results are similar. This is because the subgroup algorithm accounts relaxes constraints on whether members have to be in a subgroup, how many subgroups can be in a team, and the size of the subgroups.

Table 5: Comparison of Subgroup Algorithm with Distance Measure

	<u>Subgroup Centrality</u>	<u>Distance Measure (Bezkova et al., 2009)</u>
	SG1 SG2 SG3 SG4 SG5	Distance between two subgroups
Low faultline propensity teams	.250 .417 .333	1.364
	.250 .375 .375	1.364
	.182 .273 .227 .318	1.306
	.200 .500 .300	1.368
		0.000
		0.928
Medium faultline propensity teams	.000 .500 .500	1.732
	.208 .250 .292 .250	1.204
		1.371
	.188 .219 .219 .219 .156	1.389
		0.884
		1.099
High faultline propensity teams	.000 .500 .500	1.691
	.263 .447 .289	1.408
		1.744
		1.679
		1.467
		1.620

Note. SG1 = first subgroup, SG2 = second subgroup, and so on. If the subgroup algorithm yields more than two subgroups (as it did for teams 1 – 4, teams 8 – 9, team 10, and teams 13 – 14), then a centrality measure can be calculated. Subgroup centrality relates to the degree to which each subgroup is connected to the other subgroups. Subgroups will have higher centrality scores when they are better-connected to the other subgroups on the team.

For our algorithm, we chose a threshold value of 0.51, which means members must share more than half of the attributes in order to be considered in the same subgroup. As shown in Table 4, it becomes clear that there is some convergence between our measure and the *Fau* measure. This convergence suggests that there is overlap between the *Fau* measure and the subgroup algorithm when there are very clear divides between subgroups. However, there are important differences. For example, the subgroup algorithm broke the team into more subgroups for four of the weak faultline teams (teams 1 – 4) and broke the team into fewer subgroups for other two weak faultline teams (teams 5 and 6). This suggests that the two-subgroup strength is too stringent and should be relaxed, as is the requirement to break all teams into subgroups.

The Subgroup Algorithm Compared to the Distance Measure

Bezrukova, Thatcher, Jehn, and Zanutto (2009) introduced a measure of the distance between two subgroups. Once the two-subgroup split configurations were accounted for and the “best” configuration was chosen via the *Fau* measure, the distance between these two subgroups was calculated by accounting for the distance between the Euclidean distance between the subgroups—where each subgroup is measured by continuous variables and scaled dummy variables that reflect categorical traits. The subgroup algorithm performs a very similar calculation when it determines the distance between the best subgroup configuration in step 4 of the algorithm. However, the subgroup algorithm relaxes the two-subgroup constraint of the Bezrukova et al. measure, and thus surfaces some new possibilities for measurement and theory testing. An example is *subgroup centrality*—the degree to which a subgroup serves as the center of a team’s subgroup activity.

Example. Table 5 compares the Bezrukova et al. (2009) measure of distance to that of the subgroup algorithm. The calculation of subgroup centrality is straightforward: the proportion of dyad overlap between subgroup members and members outside of the subgroup relative to the total dyad overlap in the team. The greater proportion of overlap that subgroup members have with those in other subgroups suggests that that subgroup is more central. Applying this measure to the same dataset used in the previous example from Shaw (2004) suggests that there are a larger number of ways that subgroup centrality can arise in a team. A team can have one subgroup that is far more central than the others (e.g., team 14); two subgroups that are central and a “marginalized” subgroup (e.g., team 7); or no clear patterns of subgroup centrality (e.g., team 10). Whereas traditional faultline measures largely tap into the propensity of a team to break into subgroups, the subgroup algorithm advances the study of subgroups one step further by triggering new way of thinking about the configurations of subgroups in work teams. Perhaps members are most satisfied when there is little subgroup centrality and each subgroup has “equal voice,” while teams are better performing when the opposite is true: there is one subgroup that reigns over the others and is clearly the fulcrum of the team. Another potential benefit of a measure of subgroup centrality is a deeper understanding of the role of individual members within work teams. Of particular interest may be team leaders. Perhaps teams are more effective when leaders are in position to “span” subgroup boundaries by being in a subgroup that is central and therefore connected with all other subgroups (e.g., high communication rates with all subgroups).

Discussion and Conclusions

We presented and tested a subgroup algorithm against existing measures of faultlines. Our analysis is grounded in the notion that direct measures of subgroups are needed for research on faultlines and other topics related to work teams to move forward. There are two key benefits of a more direct and extensive measure of subgroups.

Advancing Methodology in the Study of Team Effectiveness

The subgroup measure meets the criteria laid out in the introduction. We review how it has met these criteria and also moves beyond them by providing an array of methodological benefits and opportunities for teams researchers. We then focus on the broader implications of such a measure: how the subgroup algorithm represents a methodological approach that can influence theory development as much as theory development can inform how it is used.

The value added by the subgroup algorithm. At its core, a measure of subgroups illuminates a level of analysis that has not been extensively studied by organizational researchers. A subgroup algorithm presents an opportunity to test and measure phenomena strictly at the subgroup level—a level that has not been explored deeply in field studies. Perhaps “subgroup effectiveness” (i.e., members are satisfied with their subgroup and perform effectively within it) is first needed in order for there to be team effectiveness. Processes and outcomes—such as conflict, coordination, and innovation—can also be studied between subgroups. Thus, the subgroup-based factors that mediate faultlines and team outcomes can be examined. Essentially, researchers can probe one step further into understanding the relationship between faultlines and team processes and outcomes.

Further, multi-level analyses—a key trend in research on teams in the past twenty years—can be enhanced. For example, one can examine whether an team member’s beliefs on an issue is better explained by (1) their subgroup or (2) their team. The subgroup algorithm makes it possible to capture these effects in field studies instead of having to study them in the less natural environment of the laboratory. A related advantage of the subgroup algorithm is that there are potentially four levels of analysis for which measures can be produced, and each can answer research questions at different levels of analysis: individuals (which subgroups are leaders in and how does this impact team effectiveness?), dyads (is the aggregate of relationships within the team more important than the aggregate of subgroups?), subgroups (do some subgroups contain dissatisfied members while other subgroups contain satisfied members?), and teams (how do configurations of subgroups, such as a high number versus a low number, impact team effectiveness?).

Practical advantages of the subgroup algorithm for teams scholars. The practical advantages of the subgroup algorithm come in many forms. Most important, in designing the algorithm we intentionally had an eye toward keeping the assumptions and parameters as simple and easy to follow as possible. The basic parameters are straightforward and directly reflect the theoretical basis of subgroups reviewed earlier. For example, each dyad on a team must have a certain degree of overlap (e.g., they must share three of five possible attributes) before that dyad can be considered a part of the same subgroup. The system of calculating the “best” subgroup configuration on a team is also straightforward. The thoroughness with which the best subgroup configuration is

calculated lends credibility and confidence to researchers who are interested in capturing the most impactful subgroup dynamics in a particular team.

Additionally, the subgroup algorithm is flexible because it allows researchers to have flexibility to adjust for how the context of the organization and teams affects how subgroups are formed. For example, perhaps only one trait is needed for subgroups to form (e.g., location in distributed teams). In this case, the subgroup threshold value can be set to 1 and members will either be considered in the same subgroup or in different subgroups. In other cases, it may be an amalgam of factors that researchers feel need to be considered (e.g., location, nationality, age, tenure, race, and gender). The algorithm is also flexible in that it allows for the simultaneous measurement of several types of subgroups. Thus, perhaps a researcher believes that location determines a different type of subgroup than gender. In this case, both can be measured and tested against one another and the same or different outcomes.

Finally, it is also fully possible to aggregate the subgroup measures yielded in step 6 of the algorithm to the team level in order to create team level measures of subgroup strength. These can then be used to predict the team level outcomes that dominate the literature (e.g., team satisfaction and team performance). The robustness of the algorithm can then also be tested with respect to other team level measures, including those of Thatcher et al. (2003), Gibson and Vermeulen (2003), Bezrukova et al. (2009), Li and Hambrick (2005), Shaw (2004), and Trezzini (2008). As noted earlier, we predict that the subgroup algorithm would compare favorably to existing team level measures because it has the capacity to assess how the team is characterized by important attributes at the subgroup level (e.g., subgroup count and subgroup imbalance).

Advancing Theory in the Study of Team Effectiveness

A less obvious—but we argue equally potent—advantage of the subgroup algorithm is its potential to influence theory on team effectiveness. Recently, scholars have become more sensitive to the tendency for methodological approaches drive the research questions that we ask and the analytical mindsets that we adopt (Van Maanen, SØRensen, & Mitchell, 2007; Zyphur, 2009). In this sense, the causal nature of the research process does not necessarily move in an orderly fashion from theory to methods, where a researcher draws initial research questions and hypotheses with a blank slate and then devises methods most appropriate for testing them. Instead, method often informs theory. In this vein, it is notable that the subgroup algorithm offers a host of new possible measures that have not yet been considered or theorized about by teams researchers: the proportion of team members that are in a subgroup, the average size of the subgroups, the relative imbalance of subgroups (e.g., one subgroup is much larger than others or subgroups are evenly sized), the number of subgroups, the centrality of subgroups in a subgroup network, and the positions of leaders and other individuals in the subgroup configuration of a team. These are just some examples of the factors that a subgroup algorithm surfaces, and these can guide teams researches to ask provocative research questions and ultimately steer them to new insights.

CHAPTER 3: AN EMPIRICAL TEST OF SUBGROUPS IN WORK TEAMS

A close scrutiny of research on work team processes suggests that teams often break into subgroups at some point during team engagement (Cramton & Hinds, 2005; Edmondson, 1999; Finkelstein, 1992; Guzzo & Dickson, 1996; Hackman, 1987; Kozlowski & Bell, 2003; Zellmer-Bruhn, Maloney, Bhappu, & Salvador, 2008). Teams possess subgroups when distinct subsets of team members are each characterized by a unique form or degree of interdependence (Lau & Murnighan, 1998). Consider a subgroup of marketers that clusters separately from a subgroup of engineers or a subgroup of women who share common beliefs congregating separately from a subgroup of men who share different beliefs. Due to their prevalence, subgroups have been studied in research on faultlines (Lau & Murnighan, 1998; Li & Hambrick, 2005), learning (Gibson & Vermeulen, 2003), team decision making (Kameda & Sugimori, 1995), distributed collaboration (Cramton & Hinds, 2005; O'Leary & Mortensen, 2010), social perception (Park et al., 1992), perceptions of justice (Huo et al., 1996), and knowledge sharing (Phillips et al., 2004).

One of the most common ways to study subgroups is by examining their configurational properties, with the two most well-studied configurational properties of subgroups being the *number of subgroups* and the *balance of subgroups*, i.e. whether distinct subgroups are the same size (Harrison & Klein, 2007; Harrison & Sin, 2005; Hartstone & Augoustinos, 1995; Kameda et al., 1992; Kameda & Sugimori, 1995; Mannix, 1993; Menon & Phillips, 2010; O'Leary & Mortensen, 2010; Polzer et al., 1998; Polzer et al., 2006). Despite the attention given to them by scholars, there is a tension associated with the study of both number and balance.

First, a longstanding question in the literature on subgroups relates to whether it is beneficial or detrimental for subgroups to be unequally sized (an *imbalanced* configuration in which there are majorities and minorities) or equally sized (a *balanced* configuration in which subgroups are equal in size). An eight-member team is balanced if it has two subgroups of four members each, whereas it is imbalanced if it has a majority subgroup of six members and a minority subgroup of two members. Some scholars have emphasized that teams are more effective when they are imbalanced (majorities and minorities co-exist) because subgroups are less likely to experience identity threat and teams will not become locked in “us vs. them” conflicts in which equal-sized subgroups look to protect their turf (Harrison & Klein, 2007; Harrison & Sin, 2005; Jehn & Bezrukova, 2010; Menon & Phillips, 2010; Phillips et al., 2004). Other scholars have argued that teams are more effective when subgroups are balanced (majorities and minorities do not exist) because different perspectives are equally considered, heightening the likelihood that teams will integrate distinct perspectives to achieve optimal solutions (Asch, 1956; Gibson & Vermeulen, 2003; Gigone & Hastie, 1993; Janis, 1982; Mannix, 1993; O’Leary & Mortensen, 2010; Stasser & Titus, 1985).

The second unanswered question relates to the optimal number of subgroups. Some scholars have suggested that the most destructive number of subgroups on a team is two because it promotes a competitive mentality among members of both subgroups, as they view members of other subgroups as threatening (Hartstone & Augoustinos, 1995; Phillips et al., 2004; Polzer et al., 2006). However, these findings appear to contradict decades of received wisdom from research on the benefits of informational diversity and alternative perspectives, which would suggest that teams with two subgroups would

perform better than teams with a single subgroup because there are more perspectives to bring to bear on a task or problem (Jehn, Northcraft, & Neale, 1999; Polzer, Milton, & Swann, 2002; Williams & O'Reilly, 1998).

Unfortunately, researchers have not yet undertaken a systematic analysis to address these unanswered questions related to the number and balance of subgroups. In this article, we propose that researchers who study the configuration of subgroups have not sufficiently accounted for the *type* of subgroup they are studying. We focus on two types of subgroups: identity-based and knowledge-based (Bezrukova et al., 2009; Choi & Sy, 2009). The first type of subgroup is based on identity and social categorization processes, and the second type is based on knowledge sharing and members' structural positions in the organization. We argue that scholars have not accounted for the possibility that different subgroup types are ultimately affected by number and balance in different ways. Specifically, we propose that team performance is enhanced when subgroups based on identity are characterized by majorities and minorities (imbalance) and do not exist in pairs (two subgroups are worse than one), whereas team performance is enhanced when subgroups based on knowledge are not characterized by majorities and minorities (i.e., they are balanced) and are larger in number (e.g., two subgroups are better than one).

Our analysis contributes to the literature on subgroups in work teams in three important ways. First, we link two key factors that have not yet been studied together: subgroup type and subgroup configuration. We demonstrate why it is essential to study both at the same time—if they are not studied in tandem, then scholars can reach inaccurate conclusions and make overly broad claims about whether teams benefit from

multiple subgroups or balanced vs. imbalanced subgroups. Our integration of these two constructs brings more nuance and richness into the labeling, conceptualization, and understanding of concepts such as majorities/minorities. Second, we demonstrate that the configurational properties of subgroups predict performance above and beyond faultline strength, which until now has been the dominant way to account for subgroups in work teams (Bezrukova et al., 2009; Lau & Murnighan, 1998). Finally, we employ a methodology that identifies the actual configurations of subgroups in work teams based on the characteristics of team members. Existing research investigating number and balance has been restricted to experimental or quasi-experimental settings. The wealth of field research on subgroups has thus far approximated subgroup formation with faultlines rather than identifying the precise configurational properties of subgroups.

The Interplay between Subgroup Configuration and Subgroup Type

A number of scholars have suggested that there is more than one type of subgroup, and that these different subgroups are formed according different theoretical mechanisms (Choi & Sy, 2009; Tichy et al., 1979). In particular, we focus on *identity-based subgroups*, which are formed according to social identity (Tajfel & Turner, 1986), and *knowledge-based subgroups*, which are formed according to information processing (Galbraith, 1974). Identity-based subgroups have been studied in research on diversity (Harrison et al., 1998; Phillips et al., 2004), faultlines (Bezrukova et al., 2009; Choi & Sy, 2009; Chrobot-Mason et al., 2009; Pearsall et al., 2008; Sawyer et al., 2006), intergroup conflict (Hogg & Terry, 2000), and social networks (Lazarsfeld & Merton, 1954; McPherson et al., 2001; Tichy et al., 1979). In identity-based subgroups,

individuals perceive others as belonging to subgroups that represent shared beliefs, values, and a sense of the social self. People make quick determinations about which individuals belong to their subgroup in order to simplify the social world and affiliate with those who they believe share the same sense of identity (Hogg & Terry, 2000). In the context of work teams, social identity theory would suggest that members enhance their self-worth by believing that they belong to a distinctive subgroup while comparing themselves favorably to members of other subgroups (Ashforth & Mael, 1989). Given that organizational members often shape their self-concepts according to the smallest groups to which they belong (Cooper & Thatcher, 2010), the members of each subgroup are prone to base their self-concepts at least in part according to their subgroups' identities (Turner & Onorato, 1999). Examples of identity-based subgroups are cliques (Tichy et al., 1979; Ulmer, 1965), values homophilies (Lazarsfeld & Merton, 1954; McPherson et al., 2001), relational subgroups (Choi and Sy (2009), and social subgroups (Phillips et al., 2004).

Knowledge-based subgroups are divided according to technical language, symbols, standards of communication, task-based knowledge, and approaches to problem-solving (Homan et al., 2007; March & Simon, 1958). Knowledge-based subgroups evolved as a consequence of organizations adapting to various environmental demands, resulting in distinct entities, such as units and functions, that have unique ways of filtering and processing knowledge. Research that can be brought to bear on our conceptualization of knowledge-based subgroups has been conducted by scholars of learning (Gibson & Vermeulen, 2003; Huber & Lewis, 2010), diversity (Gruenfeld et al., 1996; Phillips et al., 2004), faultlines (Bezrukova et al., 2009; Choi & Sy, 2009; Homan

et al., 2007; Sawyer et al., 2006), social networks (Balkundi et al., 2007; Burt, 1978; Roberson & Colquitt, 2005; Tichy et al., 1979), and group cognition (Nemeth, 1986; Peterson & Nemeth, 1996). Examples of knowledge-based subgroups are informational subgroups (Bezrukova et al., 2009), clusters (Tichy et al., 1979) and job-function subgroups (Sawyer et al., 2006).

Although configurational properties and subgroup type have been explored in various studies, researchers have not considered both the type of subgroup and the balance of subgroups simultaneously. Yet a close examination of the inter-subgroup behavior behind the two different subgroup types suggests that both subgroup types will be affected very differently by different configurations (different numbers and different balances) of subgroups.

The Balance of Identity-based vs. Knowledge-based Subgroups

Identity-based subgroups. Social identity theory suggests that teams will perform more effectively when they possess *imbalanced* identity-based subgroups. When there is perfect balance (e.g., subgroups are equal in size) all members of the work team will feel threatened by a salient outgroup. A work team with equal-sized subgroups is most likely to get “locked” in conflicts over issues related to values, ideologies, and beliefs (Phillips et al., 2004). In the case of perfect balance, members are most likely to thwart opportunities to traverse the divides between subgroups because they perceive that the team possesses an “us vs. them” dynamic (Harrison & Klein, 2007; Jehn & Bezrukova, 2010; Phillips et al., 2004). Indeed, measures of faultlines have been based on the theoretical assumption that a balanced configuration of subgroups is the most

destructive for team conflict (Trezzini, 2008). In short, a perfectly balanced configuration means that every team member feels threatened, whereas an imbalanced configuration means that the majority feels comfortable and only the minority feels threatened by a larger outgroup. While neither scenario is ideal because at least some team members feel threatened, the healthy interpersonal dynamics that facilitate performance are most likely to be present when identity-based subgroups are imbalanced. As shown in Figure 5, we make the following prediction:

Hypothesis 1: As the balance of identity-based subgroups increases, team performance will decrease.

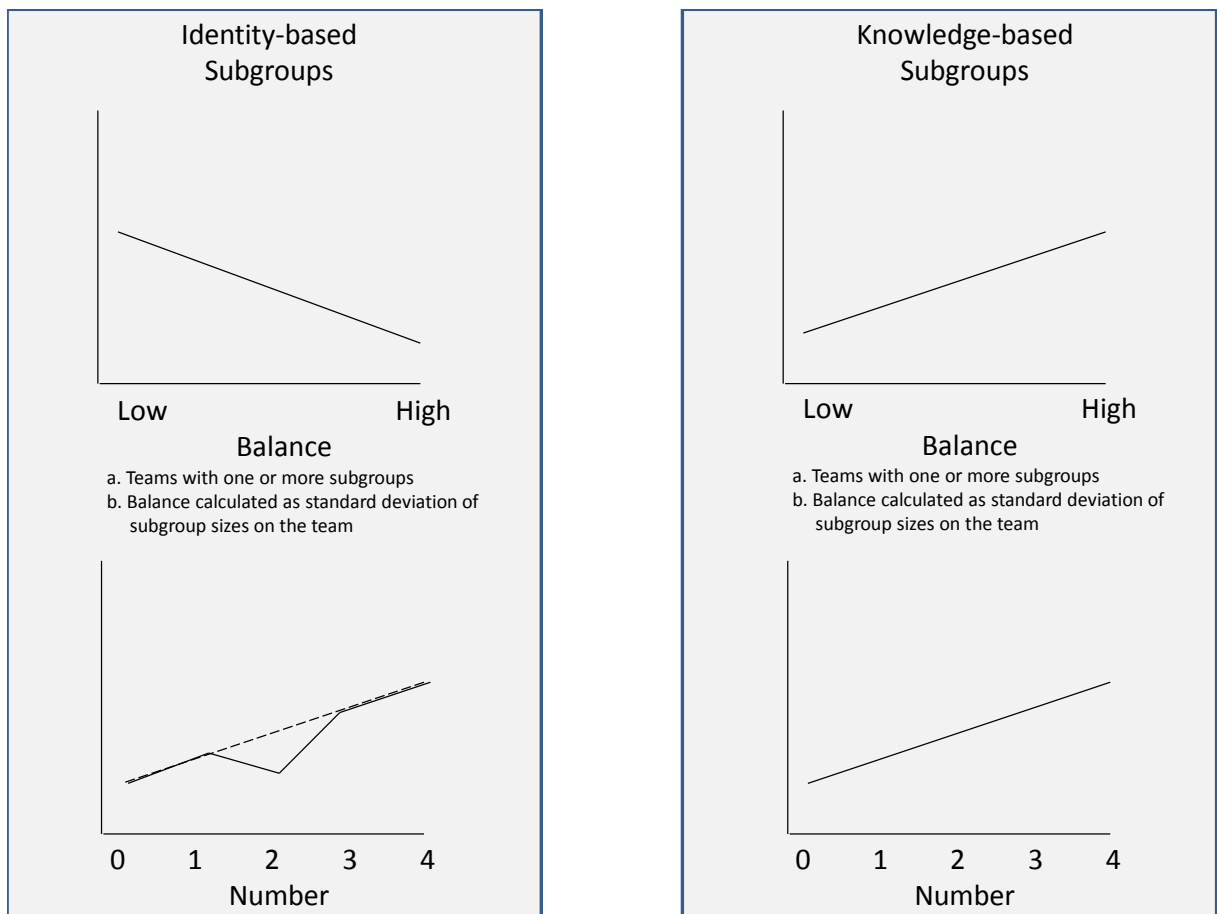


Figure 5: Hypotheses

Knowledge-based subgroups. In contrast to teams with identity-based subgroups, which we argue perform better when subgroups are imbalanced, theory related to information processing (e.g., group learning and decision making) suggests that teams benefit when knowledge-based subgroups are *balanced*. This is especially likely to be the case in knowledge-intensive environments in which innovation is favored, such as the setting for the current research, where teams with cognitive diversity are designed to leverage that diversity by giving distinct perspectives an equal voice in order to synthesize knowledge in a way that produces the most optimal and innovative task combinations (Jehn, Northcraft, & Neale, 1999; Polzer, Milton, & Swann, 2002). In teams with an imbalanced configuration of subgroups, majority mental models can “take over” team processes, and minorities are more likely to stay silent because they feel as if they do not have enough clout to be heard. Even if the final team output ultimately favors one subgroup’s mental model over others, it is important that certain viewpoints are not overshadowed or marginalized during group processes because critical expertise and skills may be expensed. In this vein, a given subgroup is least likely to be marginalized if it is as well-represented as the other subgroups on the team. Teams with balanced knowledge-based subgroups are least vulnerable to a dominant frame “taking over” and leading to group think (Janis, 1982). Similarly, members that do not feel compelled to honor a dominant, majority subgroup framework are less likely to discard uniquely held information (Gigone & Hastie, 1993; Stasser & Titus, 1985). Further, members of each subgroup have greater clout to speak up and feel that their approach to the task will be valued (Asch, 1956; Gibson & Vermeulen, 2003). In sum, an equal consideration of alternative perspectives is most likely to be facilitated when teams lack majorities and

minorities—that is, knowledge-based subgroups are balanced. As shown in Figure 5, we make the following prediction:

Hypothesis 2: As the balance of knowledge-based subgroups increases, team performance will increase.

The Number of Identity-based vs. Knowledge-based Subgroups

Identity-based subgroups. Existing research drawing from social identity theory would suggest that teams are affected by the number of subgroups in two ways. First, as the number of subgroups increases, members are more likely to experience optimal distinctiveness and multi-group identification because they possess individual identities or subgroup identities that are unique from (1) the identity of other subgroups and (2) the identity of the team (Brewer, 1991; Hogg & Terry, 2000). As the number of subgroups increases, members who belong to subgroups and members who do not belong to subgroups both feel increasingly unique. Such a sense of distinctiveness increases morale, motivation, and commitment (Hogg & Terry, 2000). The second way in which teams are affected by the number of identity-based subgroups relates to the specific occasion when they have *two* subgroups. A number of scholars have suggested that teams with two subgroups will perform the most poorly because such a configuration of subgroups yields the strongest ingroup/outgroup effect (Hartstone & Augoustinos, 1995; Phillips et al., 2004; Polzer et al., 2006). When this configuration exists, there is one salient ingroup and one salient outgroup, and teams experience an “us vs. them” mentality. Such problems are not expected to arise for teams with one subgroup (Phillips et al., 2004) or teams with three or more subgroups (Hartstone & Augoustinos, 1995; Polzer et al., 2006). In conclusion, we make two predictions (shown in Figure 5).

Hypothesis 3a: As the number of identity-based subgroups increases, team performance will increase (the dashed line in Figure 5).

Hypothesis 3b: There will be a cubic effect such that teams with two identity-based subgroups will perform worse than teams with one identity-based subgroup (the solid line in Figure 5).

Knowledge-based subgroups. Researchers investigating the number of subgroups have almost exclusively drawn on social identity theory. As noted, this perspective leads to the hypothesis that teams with two subgroups perform worse than teams with one subgroup. Yet according to the tenets of information processing, there should be a positive, linear effect whereby an increasing number of knowledge-based subgroups heightens team performance. There should be no exception for teams with two subgroups. This prediction is supported by a robust literature on informational and cognitive diversity: a greater number of perspectives enhances a team's ability to derive alternative solutions and to build innovative and novel ideas (Jehn, Northcraft, & Neale, 1999; Polzer, Milton, & Swann, 2002; Williams & O'Reilly, 1998). Beyond providing more diverse perspectives, teams with multiple subgroups have another advantage: members of each subgroup benefit from the "cohort effect" in which they can share information, merge perspectives, derive integrative combinations of skills and abilities, and take risks before integrating their output to the team level (Gibson & Vermeulen, 2003). There is neither too much diversity (where every team member has a different mental model) nor too little diversity (where most team members have the same mental model). As shown in Figure 5, we therefore make a single prediction:

Hypothesis 4: As the number of knowledge-based subgroups increases, team performance will increase.

We expect that the configurational properties of subgroups will predict team performance above and beyond faultline strength (Bezrukova et al., 2009; Lau & Murnighan, 1998). Faultlines merely suggest that there is likely to be subgroup formation, however they do not account for the configuration of subgroups. Indeed, the configuration of a team's subgroups is independent of its faultline strength, and configurational properties can vary across teams that have the exact same faultlines. Accordingly, when controlling for the degree to which members overlap with other members (i.e., faultline strength), we expect that purely configurational properties of subgroups (i.e., balance or number) will still impact performance.

Methods

Whereas previous studies of configurations have been experimental or quasi-experimental (Hartstone & Augoustinos, 1995; Kameda & Sugimori, 1995; Mannix, 1993; Menon & Phillips, 2010; O'Leary & Mortensen, 2010; Polzer et al., 2006; Sachdev & Bourhis, 1991), our investigation involved a field study. We introduce the *subgroup algorithm* as a novel way to unpack the actual configurational properties of subgroups "in the wild." Teams in this study came from a large multinational company that employs more than 100,000 employees in over 50 countries worldwide. The company is engaged in diversified operations in the food processing and food service industry, with business lines focused on crops, livestock, agricultural commodity trading, financial and risk management, and health and pharmaceutical goods. The company has over 100 units focused on a diverse array of products such as soy, beef, grains, sugar, cotton, and

fertilizer. In terms of company experience, educational attainment, organizational rank, and leader role for the study participants, 42% had more than 10 years of experience working for the company, 86% had at least a bachelor's degree, 58% had at least one company employee who reported to them, and 21% had occupied a formal team leader role.

Sample

At any given time the company had thousands of teams, most of which were temporary project teams that were time-limited, produced one-time outputs, and disbanded after the task was complete. The standard practice in the company was for a local manager to secure funding for a particular team, to recruit individuals in the organization to work on the team, and to assign one or more of the members as formal leaders of the team. As a result of the company's emphasis on using teams to work on non-routine, complex tasks in an uncertain environment, the teams can be characterized as highly knowledge-intensive.

The teams that participated in this study included all teams nominated by their local managers for a company-wide recognition program. The only explicit criteria for nomination were that teams had to have completed their tasks, thus we do not have teams in our sample that had not finished their tasks or that had stopped working on their tasks prematurely. Because managers around the world differed in their criteria for nominating a team (e.g., some managers nominated teams for simply finishing their task, some nominated teams to recognize hard work, and some nominated teams for what they viewed as a successful task output), the teams in the sample varied in their performance.

Each team was classified by the local nominating manager according to one of three task types: (1) Customer Service (e.g., task could have an impact on customers cost, profit, or revenue, or focuses on maximizing long term customer relationships), (2) Operational Improvement (e.g., task could result in significant improvement, a sustainable return, or internal growth, or there is a clear relationship between the results of the team's performance and the goals of the business unit), or (3) Product Innovation (e.g., task could be a unique and useful breakthrough for the industry, provides the company with a major competitive advantage, or is difficult to replicate or imitate). Tasks lasted a little over one year, on average, and solved a range of problems. For example, they included creating a system to charge hog producers different insurance rates based on their performance; developing a method for enabling the company to continue buying cotton when competitors were under severe pressure to obtain cash; and designing and deploying a tool to quantify vessel congestion for shipping commodities around the world.

Initially, all members of the teams that participated in the program were sent an email message from a corporate Vice-President inviting them to contribute to this study, followed up by two reminders. The response rate was 81%. The survey was written in English since this was a common language among the participants. In the beginning of the survey, each respondent was provided with the team name (which usually described the project), first and last names of members on the team, and a brief statement written by the team about the task outcome. To verify team membership, we asked survey respondents to indicate if they thought they were officially on the team, and only include those respondents who confirmed being on the team (96% of respondents confirmed, and

the primary reason given by the 4% who did not confirm was minimal participation on the team, such as providing input only once or twice). Furthermore, we only used data from teams that had at least four confirmed team members and at least a 50% response rate to our survey.

Therefore, our final sample included 2,231 members of 326 teams. Since we were able to gather background data on company experience, education level, organizational rank, and leader role from respondents only, we do not know how these characteristics differ for non-respondents. However, we do know that the final sample of teams did not differ significantly on these characteristics when compared with the teams that were excluded from the analysis due to the criteria outlined above (i.e., at least four confirmed members with at least a 50% response rate). Several months following completion of the survey, independent panels of senior executives rated team performance.

Measures

Dependent variable: Team performance. We used independent evaluations generated by panels of senior executives who were not previously familiar with the teams in the study to measure team performance. These panels judged the work of the teams on the dimensions of uniqueness, usefulness, customer engagement, value delivery, goal alignment, and tangible results. To avoid potential conflicts of interest, no senior executives were members of any of the teams, had team members as direct reports, or were nominating managers. Teams were judged within the task categories of Customer Service, Operational Improvement, and Product Innovation, ensuring that they were only judged against other teams with the same type of task.

For each task category, there were three rounds of judging, and each round was judged by a different panel of senior executives who were identified as experts in that category (the first round panels had 4 senior executives, the second round panels had 4 senior executives, and the third round panels had 3 senior executives). To reinforce that all types of tasks were valued equally by the company, the number of teams advancing in each round was proportional to the number of teams in each of the three task categories. The panels reached their decisions by consensus, and did not report raw scores or other metrics behind their judgments. Thus, we use an ordinal variable to capture whether teams ended up in the first, second, or final round of judging, coded 1: low performance, 2: medium performance, 3: high performance. Panels did not have any of the survey data described above (including member time allocation) when making judgments about team performance. Rather, they relied on a variety of information sources such as reported results, customer satisfaction, and project impact (not all types of outcome information were available for all teams, so the panels had to synthesize and integrate the different sources to make an overall judgment about performance).

Independent variables: Subgroup balance and number. The faultline model popularized the idea that subgroups form according to fixed traits (e.g., a team with two men and two women are likely to break into subgroups based on gender). This assumption has grounded a number of measures of faultlines (Gibson & Vermeulen, 2003; Lawrence & Zyphur, 2011; Li & Hambrick, 2005; Shaw, 2004; Thatcher et al., 2003; Trezzini, 2008). These measures assess the degree to which members share overlap on one or more traits. Teams have stronger faultlines when there is strong overlap among some members and weak overlap among others. Although faultline scholars can identify

which teams are likely to experience subgroup formation, no technique has yet been developed to identify the actual characteristics of the subgroups themselves (e.g., how many subgroups actually form and the number of members that each subgroup has, and which members are in these subgroups). In order to assess the balance and number of subgroups, such a technique must be developed. While adhering to the assumption that subgroups are formed according to fixed traits, we go one step further than the faultlines literature by developing an algorithm that can identify these properties of subgroups. The output of the subgroup algorithm can be used to identify the number and balance of subgroups in each work team, which we suggest will predict variance in team performance above and beyond faultline strength. Several steps are involved in this algorithm.

As noted, we adhere to the assumption of the faultline model that subgroups form from fixed traits. For identity-based subgroups, we chose age and gender. For knowledge-based subgroups, we chose supervisor (to which supervisor a member reported, as this determines in which knowledge network a member is embedded) and business unit (the nature of a member's business determines that members' expertise and knowledge sharing network). In order to identify the actual configuration of subgroups (e.g., does an eight member team have four subgroups of two members, two subgroups of four members, or some other configuration?), we had to consider the properties of *every* possible subgroup configuration on the team and compare them all with each other. Teams have many possible configurations of subgroups.

All of the possible subgroup configurations for a team of 4 members are included in the following example, whereby brackets indicate the entire configuration [A-B, C-D];

parentheses and hyphens indicate which subset of members is going to be tested to determine if they are a subgroup, such as when A and B are in the same subgroup (A-B); and commas (,) indicate divides between subgroups, such that a comma demarcates subsets A-B and C-D in the configuration [A-B , C-D]:

Possible subgroup configurations for a four person team (members A, B, C, D):

- *A subgroup of size 3 and an isolated member* – [A-B-C , D] or [A-B-D , C] or [A-C-D , C] or [B-C-D , A]
- *2 subgroups of size 2* – [A-B , C-D] or [A-C , B-D] or [A-D , B-C]
- *A subgroup of size 2 and 2 isolated members* - [A-B , C , D] or [A-C , B , D] or [A-D , B , C] or [B-C , A , D] or [B-D , A , C] or [C-D , A , B]

As shown in Table 2, the number of possible configurations of subgroups on a team increases exponentially according to size of a team. A team with three members has 3 possible configurations and a team with ten members has 115,973. In this analysis, and in line with all existing research on subgroups, we are interested in identifying which of these subgroup configurations is characterized by the *greatest amount of similarity within subgroups and the greatest amount of dissimilarity between subgroups*. In order to make these calculations, we first had to assess every dyad in the team given that the dyad is the basis of all relationships and is the only way to extrapolate the nature of every subgroup configuration on a team (Gibson & Vermeulen, 2003). To calculate dyad overlap, we followed this basic formula:

$$\frac{[(\text{Top of variable's range} - \text{Bottom of variable's range}) - (\text{Member A's value} - \text{Member B's value})]}{(\text{Top of variable's range} - \text{Bottom of variable's range})}$$

Once the overlap of every dyad was determined, we could assess every configuration of subgroups on each team (e.g., all 115,973 subgroup configurations on a ten-member team). If a configuration included subgroups with two members, then the dyad score for that subgroup would be used. If the configuration included subgroups with three members, then the dyad scores of the three members would be averaged. If the subgroup had four members, then the dyad scores for the four members would be averaged, and so on.

The next step was to determine what constitutes a set of members belonging to the “same” subgroup. A logical presumption is that, for a set of members to be a part of the same subgroup, their overlap on a series of traits should be better than chance. We therefore considered a set of members to be in the same subgroup if the amount of traits they shared was better than would be expected by chance. To consider a simple example, if there were 10 supervisors and 5 business units represented in an organization, then every dyad in a set of team members has a .1 chance of sharing the same supervisor and a .2 chance of sharing the same business unit. Given that the probability that a set of members would have overlap on one factor is independent of the probability of overlap on another factor, these probabilities should be added (not multiplied) to form a final threshold value (.3 in this case) that a set of members must surpass in order to belong to the same subgroup. Given the distributions of *age* and *gender* in our sample, the threshold value for identity-based subgroups was .70. Given the distributions of *supervisors* and *unit* in our sample, the threshold value for knowledge-based subgroups was .29. We acknowledge that the lines of chance are hard to demarcate in a dichotomous fashion given the complex nature of trait distributions, hence for all reported results we

conducted sensitivity analyses using threshold values that departed from the ones used for the primary analyses. All results reported were robust to these sensitivity analyses.

For any configuration of subgroups, the average dyad score *within* a given subset of members (e.g., members A, B, and C) must surpass the threshold value in order for the members in that configuration to be considered part of the same subgroup, and the average dyad score *between* different subsets must be below the threshold value. Using this basic formula, the algorithm runs a series of iterations in order to identify the configuration of subgroups in which there is *the strongest overlap within each subset of members and the weakest overlap between each subset of members*. The final configuration of subgroups on a team therefore meets three criteria:

1. The average dyad score of the members within each subgroup is above the threshold value.
2. The average dyad score of the members between each subgroup is below the threshold value.
3. There are no other configurations of subgroups in which the difference between the average dyad overlap within subgroups and the average dyad overlap between subgroups is greater.

The configuration of subgroups with the greatest between vs. within difference is chosen as a given team's dominant subgroup configuration. If differences between subgroup configurations are not great enough (the average dyad scores are all above the threshold) or too great (the average dyad scores are all below the threshold), then the team was considered to have no subgroups.

Once the algorithm is finished for each work team, *number* was calculated simply as the number of subgroups with two or more members, and *balance* was calculated with the standard deviation of subgroup sizes, where balance increases as standard deviation decreases. A team that has two five member subgroups has a standard deviation of 0 (and has perfect balance), whereas a team that has one two member subgroup and one eight member subgroup has a standard deviation of 3 (and thus is very imbalanced). When there was only one subgroup, balance was calculated as the standard deviation of the subgroup and the isolates, where the isolates each had a size of 1.

Control variables. We controlled for team size and average team communication. We also controlled for both identity-based faultline strength and knowledge-based faultline strength with a measure from Gibson and Vermeulen (2003).

Results

Ordered logit analysis, appropriate when the dependent variable is ordinal, estimates the odds of reaching a higher level of the dependent variable. In the case of work group performance, the coefficient estimates indicate the probability of a work group reaching a higher level of competition. In many ways this approach involves a very conservative test of the hypotheses because there is restricted variance in the dependent variable. We used Nagelkerke's pseudo- R^2 given that the assumptions of changes in regular R^2 are violated.

See Table 6 for correlations. See Table 7 for results for subgroup balance. Table 7a presents results for teams in which there were one or more subgroups. Model 1 includes control variables. As shown in Model 4, in support of hypotheses 1 and 2, the

balance of identity-based subgroups negatively impacted team performance, $b = -.222$, $p < .05$, and the balance of knowledge-based subgroups positively impacted team performance, $b = .218$, $p < .05$. Table 7b presents results for only those teams with 2 or more subgroups. We tested this sample separately because it is possible that teams respond differently when there are two or more subgroups versus just one subgroup, because only teams with 2 or more subgroups have inter-subgroup behavior. In this sample, only knowledge-based subgroup balance was significant, $b = .695$, $p = .01$.

Table 6: Correlations

	M	SD	1	2	3	4	5	6	7	8
1. Performance	.33	.63								
2. Project Size	6.76	2.59	.076							
3. Team Communication	2.84	.55	-.033	-.485						
4. Identity-based faultline strength	.53	.18	-.048	.282	-.130					
5. Knowledge-based faultline strength	.41	.24	.078	.247	-.021	.003				
6. Number of identity-based subgroups	1.22	.87	.027	.408	-.246	.453	.127			
7. Number of knowledge-based subgroups	.89	.92	.144	.403	-.366	.083	.501	.209		
8. Identity-based subgroup balance	1.37	.98	-.081	-.570	.221	-.009	-.145	.117	-.173	
9. Knowledge-based subgroup balance	1.49	.99	.013	-.546	.162	-.255	-.174	-.278	.173	.337

TABLE 7a: Results for Balance of Subgroups: Teams with One or More Subgroups

Variable	Model 1	Model 2	Model 3	Model 4
Project Size	.083	.046	.135	.099
Average team communication	.028	-.038	.114	.050
Identity-based faultline strength	-.449	-.299	-.311	-.138
Knowledge-based faultline strength	.434	-.665	.668	.922
Balance of identity-based subgroups		-.202+		-.222*
Balance of knowledge-based subgroups			.202+	.218*
Chi ² deviance	238.886	236.159	235.444	232.175
Pseudo-R ²	.026	.047	.053	.078

+significant at p < .10

*significant at p < .05

Note. Includes all teams with one or more subgroups, N = 156. Data are missing because balance cannot exist when there are 0 subgroups.

TABLE 7b: Results for Balance of Subgroups: Teams with Two or More Subgroups

Variable	Model 1	Model 2	Model 3	Model 4
Project Size	.149	.082	.350*	.268
Average team communication	.060	.070	.392	.385
Identity-based faultline strength	-.648	-.359	-2.150	-1.926
Knowledge-based faultline strength	-2.054	-1.699	-2.148	-1.655
Balance of identity-based subgroups		-.345		-.375
Balance of knowledge-based subgroups			.687**	.695**
Chi ² deviance	84.979	83.211	78.303	76,356
Pseudo-R ²	.078	.115	.212	.248

*significant at p < .05

**significant at p = .01

Note. Includes all teams with two or more subgroups, N = 55. Data are missing because balance cannot exist when there are 0 subgroups.

See Table 8 for results for number of subgroups. Model 1 includes on the control variables. As shown in Model 4, in partial support of hypotheses 1a, there was a marginally significant linear effect, $b = .823, p < .10$. In support of hypothesis 1b, there was a significant cubic effect, $b = .205, p < .05$; an increasing number of subgroups benefits teams, except when there were two subgroups, as team performance decreased between teams with one subgroup and teams with two subgroups. In partial support of hypothesis 4, the positive linear effect for number of knowledge-based subgroups on performance was marginally significant, $b = .161, p < .10$. However, it was fully significant when added into the model with just control variables, $b = .175, p < .05$. See Figure 6 for the means for the number of identity-based and knowledge-based subgroups. It should be noted that, despite the slight “V-shape” appearance of the slope of the effect for knowledge-based subgroups, the quadratic term was not significant.

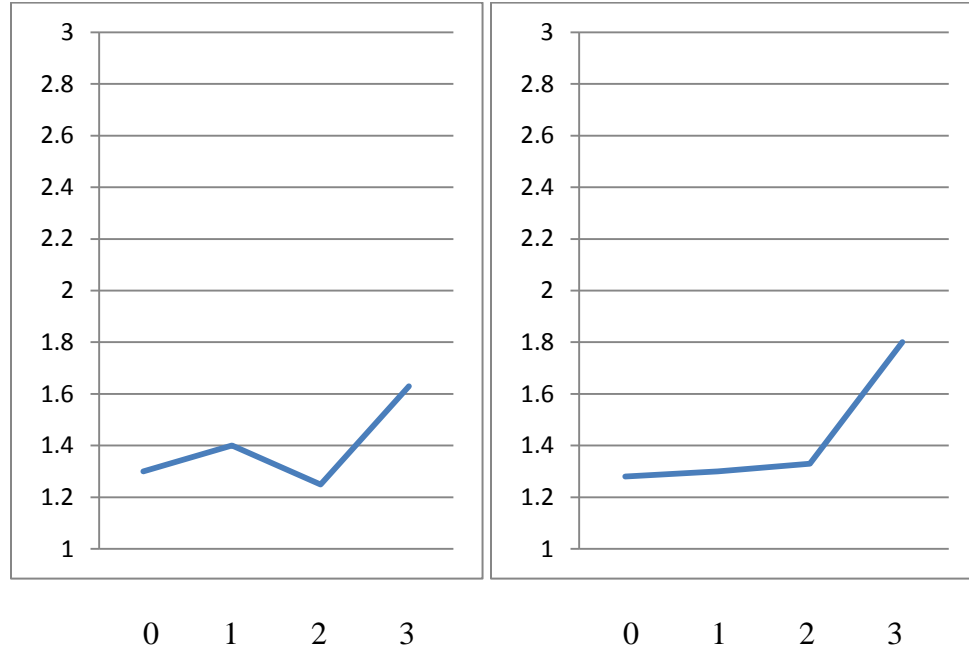
Table 8: Results for Number of Subgroups

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Project Size	.040	.037	.034	.054	.031	.046
Average team communication	.006	.012	.013	.004	.110	.098
Identity-based faultline strength	.543	.593	-.554	-.553	-.601	-.602
Knowledge-based faultline strength	.305	.298	.304	.249	.017	-.011
Number of identity-based subgroups (linear)		.028	-.063	.852*		.823 ⁺
Number of identity-based subgroups (quadratic)			.038	-.880*		-.842*
Number of identity-based subgroups (cubic)				.217*		.205*
Number of knowledge-based subgroups					.175*	.161 ⁺
χ^2 deviance	458.783	458.676	458.480	453.637	454.363	449.946
Pseudo-R ²	0.02	.020	.021	.040	.037	.055

⁺significant at p < .10

*significant at p < .05

Note. Includes all teams (those with 0 or more subgroups, N = 326).



Number of Identity-based Subgroups

Number of Knowledge-based Subgroups

Note. Data analyzed with ordinal regression. Teams either performed at level 1 (low performance), level 2 (moderate performance), or level 3 (high performance).

Figure 6: The Number of Subgroups: Actual Means

Discussion

Decades of research on subgroups has shown equivocal results regarding the merit of majority and minority composition and the merit of subgroup number in work teams. Our results shed light on when majorities/minorities are beneficial as well as the way the number of subgroups impacts team outcomes.

Subgroup Balance: When are Minorities and Majorities a Good Thing?

Various scholars have suggested that teams perform more effectively with an imbalanced configuration of subgroups characterized by clear majorities and minorities

(De Dreu & West, 2001; Harrison & Klein, 2007; Harrison & Sin, 2005; Jehn & Bezrukova, 2010; Menon & Phillips, 2010; Phillips et al., 2004), and an equally strong contingent of scholars suggesting that teams perform more effectively with a balanced configuration of subgroups (Asch, 1956; Gibson & Vermeulen, 2003; Gigone & Hastie, 1993; Janis, 1982; Mannix, 1993; O'Leary & Mortensen, 2010; Stasser & Titus, 1985). Results from our investigation suggest that both sides of the debate are correct, and that the most effective configuration of subgroups depends on the *type* of subgroup under consideration. Ultimately, our determination that different subgroup types respond in contrasting ways to the same pattern of balance contributes to a longstanding stream of research surrounding the merits of majorities/minorities.

Subgroup Number: When is “More” Better?

Various scholars have suggested that having two subgroups is the most maladaptive configuration for work teams because it enhances an “us vs. them” mindset amongst members, causing them to favor their own subgroup at the expense of members of the other subgroup, thus creating detrimental patterns of communication. Yet this research ignores received wisdom on cognitive diversity and the cohort effect. Namely, teams improve when there is an increasing number of unique informational perspectives and when these perspectives are represented by subgroups as opposed to individuals (Gibson & Vermeulen, 2003). An increasing number of perspectives adds to the pool of ideas that teams can integrate in novel ways, and subgroups provide members with protection and clout to have their viewpoints heard (Jehn, Northcraft, & Neale, 1999; Polzer, Milton, & Swann, 2002; Williams & O'Reilly, 1998). We provided insight into these divergent perspectives by suggesting that teams are disproportionately negatively

affected by two subgroups when those subgroups are based on identity. There is a discontinuity whereby teams with 1 subgroup perform better than teams with 0 subgroups and teams with 3 subgroups perform better than teams with 2 subgroups, yet teams with two subgroups perform worse than all other teams. In contrast, there is no such discontinuity between teams with 0, 1, 2, and 3 knowledge-based subgroups. An increasing number of knowledge-based subgroups simply increases performance in all cases.

Additional Contributions

In addition to helping reconcile the controversy on subgroup number and balance, our findings surface concerns with a convention in existing research: studying subgroup type independently from subgroup number and balance (Bezrukova et al., 2009; Choi & Sy, 2009; Kameda et al., 1992; Mannix, 1993; Menon & Phillips, 2010; O'Leary & Cummings, 2007; Phillips et al., 2004; Sawyer et al., 2006). The results appear to support our contention that different intergroup mechanisms drive different types of subgroup processes, and that the distinctions in these mechanisms are represented by the opposing ways that these subgroup types react to number and balance. Whereas identity-based subgroups are governed by social identity and react least favorably to salient divides between ingroups and outgroups (e.g., equal splits and teams with two subgroups), knowledge-based subgroups are governed by information processing and react least favorably when the knowledge, mental models, expertise, and information are not considered (e.g., when the view of minority subgroups are discounted by a dominant majority and when teams do not have enough subgroups). Our theory and results demonstrate that researchers can no longer make presumptions about how subgroup

configurations impact performance without precisely analyzing the mechanisms that underlie subgroup formation and processes. As opposed to the convention of studying subgroup type and subgroup balance separately, we therefore suggest that scholars study these factors together. Alternatively, if scholars study only one type of subgroup with balance, then they should clearly acknowledge which type of subgroup is being studied in order to facilitate the integration of future research.

Our research makes two other noteworthy contributions. First, our results clarified that subgroup balance and number predict variance in team performance above and beyond (controlling for) faultline strength (Lau & Murnighan, 1998). Indeed, results from our field study indicate that balance and number are stronger predictors of team performance than faultline strength for both identity-based and knowledge-based subgroups. Whereas the majority of scholars studying subgroups have used conceptualizations and measures of faultlines—the degree to which members share traits with some members and not others—scholars have not adequately accounted for the ways that the configurational properties of subgroups affect team outcomes. One likely reason for the relative void of research on subgroup balance is the difficulty of measuring balance in field research. This leads us to the final contribution of this research. Whereas the majority of studies on balance have taken place in experimental or quasi-experimental settings, our introduction of the subgroup algorithm makes it feasible to assess the configurational properties of real work teams.

Managerial Implications, Limitations, and Future Directions

The implications for managers from this research are straightforward: when possible, construct identity-based subgroups to be imbalanced and knowledge-based subgroups to be balanced, and construct teams to have more subgroups—but do not construct teams to have two identity-based subgroups. Given that a wealth of evidence suggests that subgroup formation is dependent upon the arrangement of fixed traits (e.g., age, gender, and business unit), managers would be prudent to affect these changes in the design stage of team development (Hackman, 1987). Once reaching the management and maintenance stages of team development, it may be difficult to redress the fallout from balanced identity-based subgroups or imbalanced knowledge-based subgroups or teams with two identity-based subgroups.

There are several limitations to this research that provide important opportunities for future research. Most important is that our conceptualization of the mechanisms that differentiate the way that identity-based and knowledge-based subgroups react to balance and number went untested. In line with scholars who have already assessed these mechanisms (e.g., Choi & Sy, 2009), we urge future scholars to look more carefully at the processes that make distinct subgroups react differently to the same configurations of subgroups. A second limitation of this research is that it was tested in a single context. For example, the balance of subgroups may have different effects in contexts involving resource competition (Harrison & Klein, 2007; Mannix, 1993; Sachdev & Bourhis, 1991), or in contexts in which efficiency is of prime importance (Kiesler, 1983; Nemeth, 1986). Additionally, the balance of subgroups is likely to affect outcomes differently at the subgroup level of analysis than at the team level of analysis, and thus future research

should focus on the subgroup level of analysis in greater detail (Kanter, 1977; O'Leary & Mortensen, 2010).

Conclusion

Despite an abundance of research on the configurations of subgroups in teams, little consensus has developed as to whether subgroups should be balanced or imbalanced. We presented theory and data suggesting that teams can benefit from both balance (when no majorities or minorities are present) and imbalance (when both majorities and minorities are present), with the utility of both depending entirely on the type of subgroup under consideration. Further, our research suggests that teams react differently to different numbers of subgroups, with the most important implication being that an increasing number of subgroups benefits teams with identity-based subgroups some of the time and teams with knowledge-based subgroups all of the time. We encourage future scholars to account for the type of subgroup being studied when examining the configuration of subgroups in work teams.

APPENDIX

[1A] Female 40-49 years old Black HR manager	[1B] Male 20-29 years old Native American HR manager	[1C] Female 50 or older Asian Unskilled	[1D] Male 40-49 years old Asian HR manager	
[2A] Male 30-39 years old Black Plant manager	[2B] Female 40-49 years old Native American Clerical staff	[2C] Male 40-49 years old Native American Unskilled	[2D] Male 20-29 years old White HR manager	
[3A] Male 50 or older Native American Unskilled	[3B] Male 30-39 years old White HR manager	[3C] Male 40-49 years old Asian Clerical staff	[3D] Female 50 or older Asian Clerical staff	[3E] Male 20-28 years old Asian Plant manager
[4A] Female 40-49 years old White	[4B] Male 20-29 years old Black Clerical	[4C] Male 40-49 years old Asian Unskilled	[4D] Female 40-49 years old Native	

Unskilled	staff		American HR manager	
[5A] Male 20-29 years old White Plant manager	[5B] Male 20-29 years old White Plant manager	[5C] Male 20-29 years old White Plant manager	[5D] Male 20-29 years old White Plant manager	
[6A] Female 20-29 years old White Plant manager	[6B] Male 20-29 years old White Plant manager	[6C] Male 20-29 years old White Plant manager	[6D] Male 20-28 years old White Unskilled	[6E] Male 20-29 years old White HR manager

Medium Faultline Propensity Teams

[7A] Male 50 or older Native American Clerical staff	[7B] Female 30-39 years old Asian Unskille d	[7C] Male 40-49 years old White Plant manager	[7D] Male 40-49 years old Native American Plant manager				
[8A] Male 30-39 years old Asian Plant manager	[8B] Female 20-28 years old Native American HR manager	[8C] Male 30-39 years old Native American Unskille d	[8D] Male 40-49 years old Black Unskille d	[8E] Female 40-49 years old Black Plant manager	[8F] Female 30-39 years old Asian HR manager		
[9A] Male 40-49 years old Black HR manager	[9B] Female 30-39 years old White HR manager	[9C] Female 40-49 years old Native American HR manager	[9D] Female 40-49 years old Native American HR manager	[9E] Female 40-49 years old Native American HR manager	[9F] Female 30-39 years old Native American HR manager		

[10A] Female 30-39 years old Asian Unskilled manager	[10B] Female 20-29 years old Black HR manager	[10C] Male 30-39 years old Asian Unskilled manager	[10D] Male 20-29 years old Native American Clerical staff	[10E] Female 30-39 years old Black HR manager	[10F] Male 40-49 years old White HR manager	[10G] Male 50 or older Asian Plant manager	
[11A] Male 20-29 years old White Plant manager	[11B] Male 20-29 years old White Plant manager	[11C] Male 30-39 years old White Unskilled manager	[11D] Male 20-29 years old White HR manager	[11E] Male 20-29 years old White HR manager			
[12A] Female 20-29 years old White Unskilled manager	[12B] Male 20-29 years old White Plant manager	[12C] Male 20-29 years old White Plant manager	[12D] Male 40-49 years old White HR manager	[12E] Female 20-29 years old White Plant manager	[12F] Male 20-29 years old White Plant manager	[12G] Male 20-29 years old White Plant manager	[12H] Male 20-29 years old White HR manager

High Faultline Propensity Teams

[13A] Male 20-29 years old Black Clerical staff	[13B] Male 30-39 years old White HR manager	[13C] Female 40-49 years old Native American Unskilled	[13D] Female 40-49 years old Native American Unskilled				
[14A] Male 50 or older White Plant manager	[14B] Female 40-49 years old Black HR manager	[14C] Female 30-39 years old Native American Clerical staff	[14D] Male 30-39 years old Native American Plant manager	[14E] Female 40-49 years old Black HR manager	[14F] Female 20-29 years old Native American HR manager	[14G] Female 40-49 years old Native American HR manager	[14H] Male 30-39 years old Native American Plant manager
[15A] Male 20-29 years old White Plant manager	[15B] Male 20-29 years old White Plant manager	[15C] Female 30-39 years old Asian HR manager	[15D] Female 30-39 years old Asian HR manager				

[16A] Male 20-29 years old White Plant manager	[16B] Male 20-29 years old White Plant manager	[16C] Female 30-39 years old Asian HR manager	[16D] Female 30-39 years old Asian HR manager	[16E] Female 30-39 years old Asian Unskilled			
[17A] Male 20-29 years old White Plant manager	[17B] Male 20-29 years old White HR manager	[17C] Female 30-39 years old Asian HR manager	[17D] Female 30-39 years old Asian HR manager	[17E] Male 20-29 years old White HR manager	[17F] Female 30-39 years old Asian HR manager		
[18A] Male 20-29 years old White Plant manager	[18B] Male 20-29 years old Native American Plant manager	[18C] Female 30-39 years old Asian HR manager	[18D] Female 30-39 years Asian HR manager	[18E] Male 40-49 years old White Plant manager	[18F] Male 20-29 years old White Unskilled	[18G] Female 30-39 years old Asian HR manager	

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BIOGRAPHY

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