CHAPTER 4

SORTING OUT THE FUNCTIONS AND DYSFUNCTIONS OF HIERARCHY IN TASK GROUPS: HIERARCHIZATION VERSUS CENTRALIZATION

Hierarchy is a reality of group life, for humans as well as for most other group-living species. And yet, there remains considerable debate about whether and when hierarchy can promote group performance and member satisfaction. We suggest that progress in this debate has been hampered by a lack of clarity about what hierarchy is and why it matters. Whereas prevailing conceptualizations of hierarchy in the group and organizational literature focus on centralization or steepness in power, prestige, or privilege, we build on the ethological and social network traditions to advance a view of hierarchy as cascading relations of dyadic influence. We further suggest that hierarchization, thus conceptualized, is more likely to capture the functional benefits of hierarchy whereas hierarchy as centralized power is more likely to be dysfunctional. In a study of 75 teams drawn from a wide range of industries, we show that whereas hierarchization (as cascading influence relations) reduces conflict and thereby enhances both group performance and member satisfaction, centralization has negative effects on conflict, performance, and satisfaction, particularly in groups that perform complex tasks. The theory and results of this study can help to clarify research on the functions and dysfunctions of hierarchy in task groups.

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Social relationships within interdependent groups are almost invariably hierarchical. Hierarchical forms of organizing, in which members are stratified such that higher-ranking members have more power, influence, and privileges than lower-ranking members (Mazur, 1985), have been observed in species ranging from chickens to chimps. Within the group and organization literatures, hierarchy is typically viewed as a key and even defining characteristic of formal organizations (Leavitt, 2005; Pugh & Hickson, 1976). Moreover, there is abundant evidence that informal or emergent relationships of power, status, and influence within interdependent task groups also tend toward hierarchy, even without any formal designations of authority (Magee & Galinsky, 2008; Ravlin & Thomas, 2005). Indeed, human beings seem hard-wired to think and act hierarchically (Zitek & Tiedens, 2012).

But the literature is less clear on whether hierarchical relationships in human groups are helpful or harmful for performance and viability. Some scholars have suggested that hierarchy can reduce conflict, increase coordination, encourage prosocial contributions, and even enhance learning and innovation (see Demange, 2004; Keltner, Van Kleef, Chen, & Kraus, 2008; Magee & Galinsky, 2008; Simpson, Willer, & Ridgeway, 2012; Willer, 2009). Others have noted that hierarchy frequently stifles innovation, decreases member motivation, and compromises group performance (see review in Anderson & Brown, 2010; also Auh & Menguc, 2007; Cummings & Cross, 2003; Gharabaghi & Anderson-Nathe, 2013; Grund, 2012; Rulke & Galaskiewicz, 2000). Given these contradictory predictions, a number of scholars have suggested that hierarchy may have contingent effects on group performance and effectiveness and have begun to look for moderators. Candidates include task interdependence, the legitimacy of the hierarchy, or the orientation (self vs. collective) of those members who occupy higher positions in the hierarchy (Ahuja & Carley, 1999; Anderson & Brown, 2010; Bunderson & Reagans, 2011; Halevy, Chou,

& Galinsky, 2011; Siegel & Hambrick, 2005; Van der Vegt et al., 2010).

Although the search for moderators is an important step toward sorting out the effects of hierarchy on performance, our ability to make progress in understanding the functions and dysfunctions of hierarchy has also been limited by a lack of consensus in the group and organizational literature about how to conceptualize hierarchy. Indeed, the term "hierarchy" is often used interchangeably with terms like "centralization", "steepness", "dispersion", "asymmetry", "disparity", and "inequality" in group and organization research, terms that all concern vertical stratification within social groups, but that conceptualize that stratification quite differently. Given that researchers begin with different conceptualizations, it is perhaps not surprising that they also end up adopting different operationalizations of hierarchy in their empirical work. In fact, even scholars who invoke the same terms and concepts to describe hierarchy often use different approaches to operationalize it. This lack of clarity and consensus about the essential nature of hierarchy and how to operationalize it complicates our ability to draw clear and confident conclusions from past research about the functions and dysfunctions of hierarchy in groups and organizations.

Moreover, there is also very little consensus in the group and organizational literature around the member characteristics that form the basis for hierarchical differentiation in groups. Past research has examined intra-group hierarchies based on member differences in factors such as compensation, communication, playing time, dependence, formal position, decision involvement, and conversational dominance, to name just a few. But not only does this diversity in the basis for hierarchy raise questions about the comparability of empirical findings from different studies, it is also not clear which of these factors – if any – form a reliable basis for hierarchical differentiation. The core assumption underlying the choice of any member

characteristic as the basis for hierarchy is that member differences on that characteristic will predict patterns of intra-group influence and deference (De Kwaadsteniet & Van Dijk, 2010). But research in the ethological tradition, which has been centrally interested in understanding hierarchical behavior in animal groups for decades, would suggest that a characteristics-based approach to characterizing hierarchy is flawed because member differences – however large – do not always predict who influences whom (Chase, 1980). Ethologists would suggest that we should instead be looking directly at the structure of dyadic influence relations within a group in order to determine whether those relations are hierarchically ordered.

Our purpose in the present paper is to revisit the question of *how*, *whether*, and *when* hierarchy might affect group process and performance by theoretically contrasting alternative approaches to conceptualizing hierarchy and empirically examining their consequences. We will suggest that a view of hierarchy – or hierarchization – that is grounded in and inspired by ethological and social network approaches to studying hierarchy (i.e., focusing on the hierarchical ordering of dyadic influence relations) may better capture the functional benefits of hierarchy whereas traditional, difference-based approaches to conceptualizing and operationalizing hierarchy in the organizational literature (i.e., centralization and steepness) can fail to capture those benefits – and may, in fact, be capturing dysfunctional forms of stratification. We investigate this proposition by comparing the process and performance consequences of hierarchization and centralization in a sample of 75 task groups drawn from a variety of different work settings. We then explore how the theory and results of this study can clarify and extend research on the functions and dysfunctions of hierarchy in groups.

THEORY AND HYPOTHESES

Hierarchy in the Management Literature

Within the management literature, social hierarchy has been defined as "an implicit or explicit rank order of individuals or groups with respect to a valued social dimension" (Magee & Galinsky, 2008, p. 354). Chief among the "valued social dimensions" that interest management scholars are power (i.e., control over resources), prestige (i.e., status or rank), and privilege (i.e., share of group benefits or rewards). Social hierarchy is present within a group when some members score higher on these dimensions than others (Mazur, 1985). This definition is, perhaps intentionally, quite broad. Under this definition, a group is hierarchical when one member has formal authority over others, when members differ in their levels of competence or education, when certain members dominate discussions or decisions, or when compensation is inequitable. Since differences of this sort will exist in virtually any group, it follows that social hierarchy is simply a fact of group life.

For real work groups, then, the meaningful question in examining the consequences of hierarchy is not whether or not hierarchy exists but, rather, how much hierarchy exists, or the *degree* of hierarchy within the group. Unfortunately, there is no consensus in the group and organization literatures about how we should conceptualize member differences on a given indicator of power, prestige, or privilege in order to characterize the degree of hierarchical differentiation within a group. Table 4.1 summarizes past empirical studies that have grappled with this issue in one way or another. It includes studies that seek to characterize the degree of hierarchy within a group based on member differences, and does not include studies that manipulate the presence or absence of hierarchy (e.g., De Kwaadsteniet & Van Dijk, 2010; Ronay, Greenaway, Anicich, & Galinsky, 2012), studies that utilize holistic ratings of hierarchy (e.g., Auh & Menguc, 2007; Wong, Ormiston, & Tetlock, 2011), or studies that focus on

organization-level hierarchies (e.g., Ivancevich & Donnelly, 1975). Table 4.1 groups studies based primarily on similarities in how hierarchy is operationalized in each study, since definitions and conceptualizations vary so widely in both focus and precision. Judgments about similarity in operationalizations were informed by Harrison and Klein (2007).

Our review suggested that past studies examining the degree of hierarchy in task groups have adopted three general approaches to conceptualizing and operationalizing hierarchy: 1) hierarchy as concentration or disparity in indicators of member power, prestige, or privilege (i.e., "centralization"), 2) hierarchy as separation or distance between members on indicators of power, prestige, or privilege (i.e., "steepness"), and 3) hierarchy as the ordering of dyadic influence relations (i.e., "hierarchization"). Of these three, centralization is clearly the dominant conceptualization in the literature (15 of 24 studies or 63%), followed by steepness (6 of 24 studies), with just a few isolated studies that have examined hierarchization (3 of 24 studies). We define and compare centralization and steepness in the following paragraphs, and then contrast it with hierarchization in the next section.

Centralization is the concentration of power, prestige, or privilege in one member or in a small subset of the full membership of a social group (see similar definitions in Carter & Cullen, 1984; Marsh, 1992). It is operationalized using measures of concentration, such as the Freeman (1979) index, the Gini (1936) coefficient, or the coefficient of variation, measures which quantify the distance between the highest scoring actor and all other actors on some dimension (see Harrison & Klein, 2007). Centralization is therefore maximized when one actor scores at the theoretical maximum and all other actors score at the theoretical minimum on some dimension, and is minimized when all actors have the same score. The concept of centralization is prominent in social network research, where centralization (in actor centrality scores) is a well-established measure of "stratification or inequality in the extent to which actors are involved in relations"

(Ibarra, 1992, p. 170). The concept of centralization is not limited to social networks, however, but is relevant in any setting where actors differ in their possession of valued social or material resources. In fact, centralization is conceptually identical to what Harrison and Klein (2007) have called "disparity", a form of intra-group diversity that focuses on vertical or status differences.

A second, less common, approach to conceptualizing the degree of hierarchy in social groups is to focus on "steepness" (Anderson & Brown, 2010; De Vries, Stevens, & Vervaecke, 2006). Steepness has been defined as "asymmetries in members' power, status, and influence" (Anderson & Brown, 2010, p. 56). It is operationalized using measures such as the standard deviation[7] or mean Euclidean distance, measures which get at "the size of the absolute differences between adjacently ranked individuals" (De Vries et al., 2006, p. 585). Steepness is therefore maximized when half of a group scores at the theoretical maximum on some dimension and the other half scores at the minimum. Steepness is conceptually indistinguishable from what Harrison and Klein (2007) have called "separation", although it concerns vertical rather than horizontal differences. Given that centralization and steepness both derive from inequalities in member power or influence, the two constructs will tend to be correlated[8] and effects will tend to converge.

In terms of specific findings, Table 4.1 paints an equivocal picture of the effects of centralization and steepness. Whereas centralization and steepness have positive effects on group process or performance in some studies (e.g., Frick, Prinz, & Winkelmann, 2003; Halevy, Chou, Galinsky, & Murnighan, 2012; He & Huang, 2011; Main, O'Reilly, & Wade, 1993; Siegel &

[7] Some scholars have used the coefficient of variation to measure steepness (Hemelrijk, 1999), which normalizes dispersion relative to the group mean. Harrison & Klein (2007) suggest that the coefficient of variation is better thought of as a disparity measure.

[8] To explicitly examine this correlation, we computed centralization (using Freeman, 1979) and steepness (standard deviation) for all of the theoretically possible configurations of influence centrality scores (the number of others over whom one has influence) in a six-person team (N = 46,656 possible configurations). The correlation between centralization and steepness was .63.

Hambrick, 2005), they have negative or null effects in an even larger number of studies (e.g., Ahuja & Carley, 1999; Bloom, 1999; Bunderson, 2003a, 2003b; Frick et al., 2003; Grund, 2012; Huang & Cummings, 2011; Jewell & Molina, 2004; Leonard, 1990; Richards & Guell, 1998; Rulke & Galaskiewicz, 2000; Siegel & Hambrick, 2005; Small & Rentsch, 2010). Moreover, while this mixed pattern of results would seem to suggest that moderators are at play (see Anderson & Brown, 2010; Halevy et al., 2011), results of studies that explicitly examined moderators have also been equivocal. For example, some studies find that hierarchy is negatively related to performance for more complex, intensive tasks (Ahuja & Carley, 1999; Bloom, 1999; Grund, 2012; Huang & Cummings, 2011; Siegel & Hambrick, 2005) whereas others find that hierarchy is positively related to performance for more complex, intensive tasks (Frick et al., 2003; Halevy et al., 2012).

While we would agree that the search for moderators is part of the solution, Table 4.1 makes it clear that we as researchers must also resolve two key conceptual and operational questions about hierarchy before we can draw firm conclusions from past studies. First, does it matter which member characteristics – pay, interaction/communication, leadership, influence – one uses to conceptualize hierarchical differentiation in groups, or does stratification in any indicator of power, prestige, or privilege yield essentially the same results? And second, does it matter how we conceptualize and operationalize hierarchy – centralization, steepness, hierarchization – or are these alternative approaches essentially interchangeable? We will suggest that the answer to both of these questions is that it does matter. And in order to understand why, we must work to better understand the third, and least frequently examined, type of hierarchy that emerged in our review of the literature – hierarchization.

Table 4.1

A review of empirical studies that characterize the degree of hierarchy in human groups based on member differences[9]

Study	Basis of hierarchical differentiation	Conceptualization (and operationalization) of hierarchy	Study and findings
CENTRALIZATION *Includes studies that examine concentration or disparity within a group. Operations include the Freeman index, Gini coefficient, and coefficient of variation.*			
Gladstein & Reilly (1985)	Peer influence ratings	"Decision centrality" (degree centralization; a la Freeman)	N = 24 student groups in a management simulation. Degree of influence centralization was not affected by changes in time pressure and stakes.
Argote, Turner, & Fichman (1989)	Communication frequency	"Centralization" (following MacKenzie, 1966)	N = 20 student groups in the lab. Groups facing high uncertainty and low threat became more centralized.
Main, O'Reilly, & Wade (1993)	Executive compensation	"Executive team wage dispersion" (coefficient of variation)	N = 209 top management teams of public firms over 5 years. Executive team wage dispersion was positively related to return on assets.
Ahuja & Carley (1999)	E-mail communication	"Network structure: Centralization" (degree centralization; Freeman)	N = 928 e-mail communications in a virtual organization. Less centralized and less hierarchical communication networks were associated with higher performance for non-routine tasks.
Bloom (1999)	Player salary	"Pay dispersion" (Gini coefficient and coefficient of variation)	N = 236 major league baseball teams, 1985-1993. Teams with more concentrated pay structures performed worse financially and on the field.
Rulke & Galaskiewicz (2000)	Combined: interdependence, frequency of work interaction, and communication	"Network decentralization" (degree centralization; Freeman)	N = 39 MBA student teams in a simulation. Teams of specialists performed worse than teams of generalists unless they had decentralized structures.
Bunderson (2003a)	Peer influence ratings	"Power centralization" (degree centralization; Freeman)	N = 209 technicians in 35 teams. Expertise attributions were more likely to be based on valid cues in decentralized teams.
Bunderson (2003b)	Peer ratings of workflow interactions and decision involvement.	"Power centralization" (degree centralization; Freeman)	N = 44 management teams. Broad functional experts were more involved in team decisions when power was decentralized.

[9] This review focuses on studies that characterize the *degree* of hierarchy within human *groups* based on member *differences*, and does not include studies that manipulate the presence or absence of hierarchy (e.g., De Kwaadsteniet & Van Dijk, 2010; Ronay et al., 2012), studies that are based on holistic ratings of hierarchy (e.g., Auh & Menguc, 2007; Wong, Ormiston, & Tetlock, 2011), or organization-level studies (e.g., Ivancevich & Donnelly, 1975).

Frick, Prinz, & Winkelmann (2003)	Player salary	"Pay inequality" (Gini coefficient)	N = 1,224 team-year observations across NFL, MLB, NHL, and NBA teams. NFL and MLB teams won more of their games when pay was more equal. MLB and NHL teams won more games when pay was more unequal.
Jewell & Molina (2004)	Player salary	"Salary inequality" (Gini coefficient)	N = 438 major league baseball teams, 1985-2000. Teams with more unequal pay performed worse on the field (winning percentage).
Berdahl & Anderson (2005)	Peer ratings of leadership within the group	"Leadership centralization" (degree centralization; a la Freeman)	N = 29 student groups performing interdependent tasks in the lab. Leadership centralization was higher in all-male and mixed groups. Majority female groups became more decentralized over time than did majority-male groups.
Siegel & Hambrick (2005)	Executive compensation	"Top management group pay disparity" (coefficient of variation)	N = 67 top management groups of U.S. firms. Variation in executive compensation was negatively related to firm performance (market-to-book and total shareholder return) for more technologically intensive firms, but not for less technologically intensive firms.
Small & Rentsch (2010)	Leadership behaviors (change-oriented, task-oriented, relations-oriented)	"Shared leadership" (degree centralization; Freeman)	N = 60 student teams working on a simulation. Centralization of leadership was negatively related to team performance.
He & Huang (2011)	Number of outside board memberships	"Board membership inequality" (Gini coefficient)	N = 530 boards of manufacturing firms, 2001-2007. Board membership inequality was positively related to firm financial performance (ROA).
Grund (2012)	Passes between professional soccer players	"Centralization of interaction" (degree centralization; Freeman)	N = 283,259 passes from 23 soccer teams. Centralized passing networks were negatively related to number of goals scores in a match.
STEEPNESS *Includes studies that examine separation or distance between group members. Operations include standard deviation and average distance.*			
Leonard (1990)	Executive compensation	"Variance and steepness of managerial pay" (variance = SD; steepness = ratio of pay at top to pay at the bottom)	N = executive groups in 439 large U.S. corporations, 1981-1985. Variance and steepness of executive compensation was unrelated to firm performance.
Richards & Guell (1998)	Player salary	"Variance of the team's salary" (variance)	N = 112 MLB teams, 1992-1995. Teams with more dispersed salaries did marginally worse.

Van der Vegt, De Jong, Bunderson, & Molleman (2010)	Peer ratings of power-dependence	"Power asymmetry" (mean absolute distance in dyadic power-dependence)	N = 46 teams in the field. Power asymmetry was negatively related to learning and performance when teams received individual feedback but positively related to learning and performance when teams received group feedback.
Greer & Van Kleef (2010)	Level in the organizational hierarchy	"Power dispersion" (standard deviation)	N = 42 groups in a finance firm. Power dispersion was positively related to power struggles and conflict in high-power teams but negatively related to those same outcomes in low-power teams.
Halevy, Chou, Galinsky, & Murnighan (2012)	Pay, starting lineup position, and playing time	"Hierarchy" or "Dispersion" (standard deviation)	N = 254 NBA basketball teams (11 seasons). Teams with higher pay and starting lineup dispersion were more cooperative (as measured by assists, turnovers, defensive rebounds, and field goal percentage) and won more of their games.
Huang & Cummings (2011)	Knowledge sharing behavior	"Critical knowledge centralization" (mean Euclidean distance in member centrality)	N= 177 teams in a multi-national food company. Knowledge centralization was negatively related to executive-rated team performance, especially when members came from different business units or were sharing new knowledge.
HIERARCHIZATION *Includes studies that examine the ordering of dyadic influence relations within a group. Operations include linearity and degree of hierarchy.*			
Ahuja & Carley (1999)	E-mail communication	"Network structure: Hierarchy" (degree of hierarchy; Krackhardt)	N = 928 e-mail communications in a virtual organization. Less centralized and hierarchical communication networks were associated with higher performance for non-routine tasks.
Mast (2002)	Interruptions during group discussion	"Hierarchical organization" (degree of linearity in dominance relations)	N = 58 men and 58 women organized into 28 same-sex groups. Groups engaged in two leaderless discussions. All-male groups began the first discussion with a more linear dominance hierarchy but converged with all-female groups by the end of that discussion. This pattern was reversed during the second discussion, with female groups starting out more linear.
Cummings & Cross (2003)	Communication frequency	"Hierarchical structure" (degree of hierarchy; Krackhardt)	N = 182 work groups in a Fortune 500 telecommunications firm. Hierarchical communication structures were negatively associated with performance.

Hierarchy as Cascading Influence Relations

In 1922, Thorleif Schjelderupp-Ebbe coined the term "pecking order" (*Hackordnung*) to describe the clear dominance hierarchies that he observed among chickens, hierarchies that emerged from aggressive encounters (i.e., pecking behavior) (Schjelderupp-Ebbe, 1935). Since that time, the existence of dominance hierarchies across a wide range of species, including humans, has been one of the more robust and well-studied findings in the ethological literature (Chase, 1980; Mazur, 1985). Researchers have found that dominance hierarchies are pervasive, that they emerge quickly, and that they are quite stable (Bernstein, 1969; Demange, 2004; McDonald & Shizuka, 2013). Moreover, researchers have observed that dominance hierarchies tend to be highly linear (Chase, Tovey, Spangler-Martin, & Manfredonia, 2002; Shizuka & McDonald, 2012). A dominance hierarchy is linear when A dominates all others group members, B dominates all but A, C dominates all but A and B, and so forth. In other words, in a perfectly linear hierarchy, dominance has been resolved in every dyad and every triad is transitive (i.e., if A > B and B > C then A > C, where ">" indicates dominance) (McDonald & Shizuka, 2013). As a result, there is never any uncertainty about who dominates whom.

A number of scholars have suggested that the transitive – or perhaps more accurately, cascaded – ordering of influence relations (rather than dominance relations; see Mazur, 1985) is the essence of hierarchy in human groups as well. The archetype of a human hierarchy is the tree structure (Corominas-Murtra, Goni, Sole, & Rodriguez-Caso, 2013; Demange, 2004; Izar, Ferreira, & Sato, 2006; Kemp & Tenenbaum, 2008; Krackhardt, 1994). In the most complex of trees, the trunk can split into any number of branches which can split into any number of limbs which can split into any number of twigs. But twigs do not reconnect into limbs and branches do not reconnect into the trunk. Similarly, in a pure influence hierarchy, person A can have influence over any number of B's who in turn have influence over any number of C's who in turn have

influence over any number of D's. But if in such a hierarchy D_x has influence over A, we no longer have a pure hierarchy.

Unlike the linear hierarchies that emerge in animal groups, a tree structure does not require that all triads be transitive. In fact, a tree structure presumes that influence in many dyads will be unresolved. This is a key feature of influence relations in human task groups (Martin, 2009). Individuals A, B, and C may have no influence relation at all because they operate in different departments of a firm or on different subtasks within a group. But a tree structure *does* require that the structure of influence relations not be intransitive, where an actor lower in the hierarchy has influence over someone who has direct or indirect influence over her. Put differently, influence relations in a tree structure are cascading and, like water cascading over rocks, never flow upstream. In social network terms, a tree structure is a digraph with asymmetric reachability, i.e., a network structure in which influence relations are directed (i.e., from one actor to another) and where if there is a path from A to D, then there is not also a path from D to A (see Krackhardt, 1994; McDonald & Shizuka, 2013). Violations of this principle introduce uncertainty into what would otherwise be a clearly ordered set of influence relations.

A nice example of hierarchy as cascading influence relations can be found in Klein, Ziegert, Knight, and Xiao's (2006) study of leadership structures in trauma care medical teams. An attending surgeon in their study described her team's dynamics as follows: "[T]here is a very rigid hierarchy underlying that. The flow is one way. The fellow can always supersede the resident, but the resident can't supersede the fellow. The attending can always supersede the fellow and the resident, but neither one of them can supersede the attending" (p. 602). Klein et al. (2006) found that a clear team hierarchy set the stage for flexible and adaptive leader behaviors to emerge within these teams.

Hierarchization provides a very different approach to conceptualizing social hierarchy than either centralization or steepness. Whereas hierarchization begins with dyadic influence relations and examines whether those relations are hierarchically ordered, centralization and steepness begin with indicators of member power, prestige, or privilege and examine disparity or difference between members on those indicators (see Chase, 1980, p. 907). With hierarchization, the question is not which members get paid more, are more central, or receive more leadership or higher expertise ratings but, rather, whether the overall pattern of dyadic influence relations within the group is cascading. The basis for hierarchical differentiation in determining hierarchization is therefore dyadic influence – not those factors that may affect dyadic influence (which may be antecedents), or even aggregate measures of influence, but actual dyadic influence relations.

It is, of course, possible that the two are closely related, i.e., that stratification in indicators of intra-group power or prestige will predict the hierarchical ordering of influence relations. Indeed, this is what most researchers implicitly or explicitly assume is the case (see De Kwaadsteniet & Van Dijk, 2010; Ronay et al., 2012, p. 2). After all, we know from expectation states research that status characteristics are positively and significantly correlated with influence in task groups (Berger, Cohen, & Zelditch, 1972). But as Chase (1980) has demonstrated, in order for member characteristics of any type to predict hierarchies of even moderate linearity, the correlation between member characteristics and dyadic influence would have to be unreasonably high (e.g., above .90), much higher than the correlations that have typically been observed in either animal or human groups. The same is true for omnibus measures of power, prestige, or privilege. As a result, if the goal is to understand the extent to which hierarchy is actually enacted within a social group, hierarchization is a much more direct and valid indicator of hierarchy than either centralization or steepness.

Process and Performance Effects of Hierarchization and Centralization

As noted earlier, the ubiquity of hierarchy across group-living species has led many researchers to conclude that hierarchy must serve adaptive and functional roles (Demange, 2004; Halevy et al., 2011; Moosa & Ud-Dean, 2011). While past attempts to articulate those functions have offered various explanations, a central and recurring theme is that hierarchy provides a robust solution to conflict and coordination problems by shaping patterns of deference and influence. So, for example, Moosa and Ud-Dean (2011, p. 204) argue that a stable hierarchy in an animal group "reduces fighting cost for resources of both dominant and subordinate individuals compared to unstable systems where no hierarchy is present". Demange (2004, p. 756) developed a formal model of conflict (i.e., blocking behavior) and coordination in hierarchical (defined as a tree structure) versus non-hierarchical groups and concluded that "a hierarchical decision process is shown to be … much more efficient in reaching stable outcomes than other processes". Ronay et al. (2012) argued that "When there is a clear hierarchy, division of labor and patterns of deference reduce conflict, facilitate coordination, and ultimately improve productivity" (see also Anderson & Brown, 2010; Greer, 2014; Magee & Galinsky, 2008; Simpson et al., 2012).

We will suggest that a view of hierarchy as cascading relations of dyadic influence (i.e., hierarchization) is much more likely to serve these conflict-resolution and coordination functions than a view of hierarchy as the magnitude of member differences in power, prestige, or privilege (i.e., centralization or steepness). In order to allow for a more focused theoretical elaboration of this proposition, we will specifically compare hierarchization with centralization, leaving a comparison of hierarchization with steepness for future research. This seems appropriate given that centralization is the most common approach to conceptualizing hierarchy in the group and organization literatures. Moreover, as we demonstrated earlier, centralization and steepness tend

to be correlated and we would therefore expect their effects to converge. We will, however, revisit the question of steepness in our post hoc analysis.

Recall that hierarchization reaches its theoretical maximum when all influence relations within a group are cascading. When influence relations are perfectly hierarchical, there is no circularity in questions of deference and therefore no question about who has the ultimate say when disagreements arise, or when the group needs direction. In contrast, lack of hierarchical ordering creates an environment where conflicts are both more likely (because it is not clear whose opinions, proposals, or directions should be given greater weight) and more problematic (because there is no accepted arbiter to resolve those conflicts). In other words, hierarchization serves to structure and direct influence relations between and among group members in a way that allows for the resolution of conflict and the coordination of effort. This is essentially the argument for hierarchy that has been advanced in past theory and research and that was just reviewed in the above paragraph.

In contrast, centralization reaches its theoretical maximum when one member has maximum influence and others are at the minimum. In other words, centralization is maximized when a) the differences between high- and low-ranking members are large and b) some members have identical low rankings[10]. This would seem to be a perfect recipe for jealousy, rivalry, competition, coalition-building, and conflict as those members with identical low ranks jockey with one another in their attempts to influence outcomes in their favor or to curry favor with higher-ranking members. This is consistent with past research which has suggested that the centralization of power or influence within a group leads to political behavior, coalition-building, and upward influence (Bendersky & Hays, 2012; Eisenhardt & Bourgeois, 1988; Ibarra, 1992). These political dynamics are not only disruptive and inefficient, they also tend to result in

[10] Although we are focusing on centralization here, it is worth noting that this statement is also true for steepness.

decisions that favor socially-advantaged members (e.g., members of a demographic majority) and not necessarily competent members (Bunderson, 2003a; 2003b).

In short, we expect that hierarchization will decrease and centralization will increase the conflicts that arise as group members strive to coordinate their work. Researchers have suggested that conflict in small groups can take a variety of different (but correlated) forms, including conflict about the technical elements of a task (task conflict), about interpersonal relations and compatibilities (relationship conflict), about how to organize member roles, responsibilities, and relations in order to perform a group's work (process conflict), and about relative member standing in the group (status conflict) (see Behfar, Mannix, Peterson, & Trochim, 2011; Bendersky & Hays, 2012; De Wit, Greer, & Jehn, 2012; Jehn, 1997). Hierarchization could potentially reduce all of these forms of conflict since a clear ordering of influence relations provides a means by which disagreements of any type can be resolved. We will focus here on process conflicts, however, because our earlier arguments imply that hierarchization will promote group effectiveness by providing a means by which group members can resolve disagreements related to organizing roles, responsibilities, and relations – i.e., process conflict. We will, however, consider other forms of conflict in our post hoc analyses. Process conflict has been shown to relate consistently and negatively to adaptive group processes (e.g., cohesion, satisfaction) and outcomes (e.g., innovativeness) (Behfar et al., 2011; Greer, Jehn, & Mannix, 2008; Jehn, Greer, Levine, & Szulanski, 2008; Matsuo, 2006; see also meta-analysis by De Wit et al., 2012).

In sum, we hypothesize that the centralization of influence relations within a group will increase process conflict whereas the hierarchization of influence relations will decrease process conflict. To be complete, however, our hypotheses must also acknowledge that centralization can overlap with hierarchization. As noted earlier, a centralized influence structure can be more or less hierarchical. And if influence relations in a centralized group are hierarchically ordered, that

ordering may help to resolve some of the coordination problems described earlier. At the same time, it may be that the advantages of hierarchization will be mitigated in centralized groups. In other words, we expect that hierarchization will reduce process conflicts after accounting for any negative effects of centralization and that centralization will increase process conflicts after accounting for any positive effects of hierarchization. Stated formally:

> *Hypothesis 1: When controlling for the centralization of influence relations within a group, the hierarchization of those relations will be negatively associated with process conflict within the group.*
>
> *Hypothesis 2: When controlling for the hierarchization of influence relations within a group, the centralization of those relations will be positively associated with process conflict within the group.*

It is important to note that Hypothesis 1 is explicitly about the hierarchization of *influence* relations and not about the hierarchization of other types of intra-group relations. It is not at all clear that hierarchically-ordered communication relations, for example, will have the same benefits (see Cummings & Cross, 2003).

The Moderating Role of Task Complexity

Hypothesis 1 and 2 propose direct effects of hierarchization and centralization on process conflict in groups. But past theoretical work has suggested that the effects of hierarchy on intra-group processes are likely to be moderated by characteristics of a group's task (Anderson & Brown, 2010; Halevy et al., 2011). For example, a number of scholars have suggested that hierarchy will have different implications for group process and performance in groups that perform simple versus complex tasks (Ahuja & Carley, 1999; Anderson & Brown, 2010; Siegel & Hambrick, 2005).

Task complexity concerns the clarity, routineness, predictability, and standardizability of group tasks (Withey, Daft, & Cooper, 1983). As tasks become more complex, unforeseen problems and exceptions are more likely to arise, requiring case-by-case problem solving and decision making in order to appropriately adapt group processes and procedures to task demands. As a result, there is a greater need for members to exercise individual and collective judgment and discretion in the execution of complex tasks, which creates more opportunities for group members to disagree about the best way to resolve particular problems or address particular situations (Bigley & Roberts, 2001; Siegel & Hambrick, 2005). Clearly ordered influence relations (i.e., hierarchization) should therefore become especially important for teams that perform complex tasks since hierarchization provides a ready means by which these conflicts and disagreements can be avoided and, if they arise, resolved. In contrast, task complexity should exacerbate the conflict and coordination problems that arise in centralized groups since each new twist or turn in task demands provides a fresh opportunity for members to squabble and posture about how to proceed and about whose ideas are best. These arguments are consistent with the findings of Ahuja and Carley (1999) and Siegel and Hambrick (2005) who found that centralization was negatively associated with team performance in teams that performed more complex tasks. We therefore hypothesize:

Hypothesis 3: Task complexity will moderate the negative relationship between hierarchization and process conflict; the relationship will be stronger in teams that perform more complex tasks.

Hypothesis 4: Task complexity will moderate the positive relationship between centralization and process conflict; the relationship will be stronger in teams that perform more complex tasks.

Implications for Group Performance and Member Satisfaction

Finally, we would suggest that hierarchization and centralization will have consequences for both group performance and member satisfaction because of their effects on process conflict. Past research has demonstrated a consistent and negative relationship between process conflict and group performance (Behfar et al., 2011; Passos & Caetano, 2005; Vodosek, 2007; see meta-analysis by De Wit et al., 2012). Process conflicts compromise group performance because member energy and attention is diverted from task accomplishment and toward resolving debates and disagreement about *how* to accomplish tasks, i.e., who should perform what tasks, how to manage scheduling and workflow, what to do with free riders, etc. (Passos & Caetano, 2005). As Behfar et al. (2011, p. 128) noted, process coordination and the avoidance of process losses lie at the heart of our theorizing about group effectiveness. We therefore hypothesize that hierarchization and centralization will have indirect effects on group performance through their effects (direct and task-contingent) on process conflict. Formally:

> *Hypothesis 5: Hierarchization will have a positive indirect effect on group performance through its effect on process conflict.*
>
> *Hypothesis 6: Centralization will have a negative indirect effect on group performance through its effect on process conflict.*

Whereas scholars often disagree about whether hierarchy is good or bad for group performance, there is considerable agreement about the effects of hierarchy on member satisfaction and morale. In short, scholars have long suggested that hierarchy undermines member satisfaction (Leavitt, 1951). Even in the animal literature, researchers note that despite its apparent benefits for group-living species, "hierarchy imposes stress-related burdens at the individual-level on a longer timescale" (Moosa & Ud-Dean, 2011, p. 204). These stress-related burdens increase the risk of stress-related diseases such as hypertension, depression, and heart

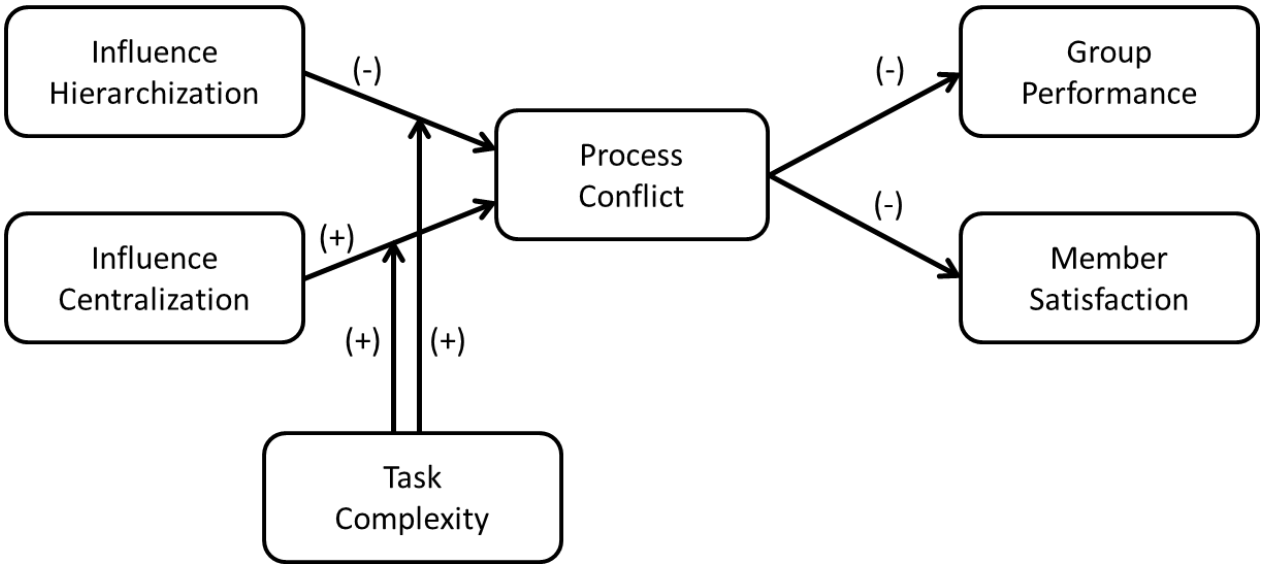
disease (Sapolsky, 2005). In a review of group and organization research on stratification, Anderson and Brown (2010, p. 64) concluded that "Taller hierarchical structures almost always predicted worse attitude-related outcomes".

We would suggest that, at least in human groups, these negative attitudinal effects of hierarchy may be due to centralization and not to the hierarchization of dyadic influence relations. We have suggested that centralized or steep networks foster process conflict whereas hierarchization reduces process conflict. There is strong evidence in the literature to suggest that process conflict heightens uncertainty and fosters negative emotion in groups. In their recent meta-analysis, for example, De Wit et al. (2012) found strong negative relationships between process conflict and trust, cohesion, satisfaction, commitment, identification, and organizational citizenship behavior. At the same time, they found that decreases in process conflict increased these positive attitudinal outcomes. We would therefore expect that by heightening process conflict, centralization can have negative effects on member satisfaction in groups. In contrast, by reducing process conflict and smoothing coordination, hierarchization should have a positive effect on satisfaction. We therefore hypothesize:

> *Hypothesis 7: Hierarchization will have a positive indirect effect on member satisfaction through its effect on process conflict.*
>
> *Hypothesis 8: Centralization will have a negative indirect effect on member satisfaction through its effect on process conflict.*

Our theoretical model is summarized in Figure 4.1.

Figure 4.1 *The research model*



DATA AND METHOD

Sample and Procedures

Past research on hierarchy in teams has been conducted in a wide range of team settings, including top management teams, research teams, sports teams, student groups, boards of directors, manufacturing teams, telecommunications teams, and customer service teams (see Table 4.1). Given this broad sample of teams, one explanation for the equivocal pattern of results in past research is that the effects of hierarchy will vary depending on the type of team studied. In order to mitigate this concern in the present study, we adopted a data collection approach that was explicitly designed to create a diverse sample of different types of teams, while utilizing a standard data collection protocol so that all teams could be studied together.

Specifically, with the help of a team of research assistants, we identified existing work teams in the field that met the following basic definition of a team: groups must a) have at least 4-

5 members, b) perform organizationally-relevant work (not trivial tasks), c) interact frequently face-to-face, d) share resources and information, and e) coordinate efforts toward the accomplishment of joint goals (see Kozlowski & Bell, 2003). Once eligible teams were identified, supervisors were contacted by a member of our research team and invited to participate in a study of team characteristics and member interactions. When a team supervisor agreed to cooperate, he or she provided us with additional information such as the nature of the tasks performed by the team, the size and industry sector of the organization, and the names of team members.

Data were then collected using standardized data collection instruments and procedures. Two separate surveys were distributed: a team member survey and a supervisor survey. In the team member survey, members rated dyadic influence, task complexity, process conflict, and job satisfaction. Supervisors were always external to the team, and were therefore not included in the team member survey. Supervisors rated overall team performance only. All data were collected within a two month period.

The final sample consisted of 457 respondents from 75 work teams in 56 different organizations. The overall response rate among participating work teams was 94% and the average within-team response rate was 95%. Table 4.2 provides a summary of the types of teams that were included in our final sample, along with a brief description of team tasks. As we intended, these teams came from a wide range of organizations, industries, and sectors. For example, teams came from 13 different industries, including information technology, hospitality, finance, consulting, agriculture, transportation, telecommunications, education, manufacturing, and government services. Twenty-eight teams (37%) worked in branch offices. In terms of organization (or branch office) size, 11 teams (15%) worked in organizations or branches with fewer than 20 employees, 17 (23%) in organizations or branches with between 21 and 100

employees, 22 (29%) in organizations or branches with between 100 and 500 employees, and 20 (27%) in organizations or branches with more than 500 employees. Forty-one (55%) of these organizations came from the for-profit sector, with 34 (45%) not-for-profits.

Teams had 6.47 members on average (*SD* = 2.22), with an average team tenure of 3.95 years (*SD* = 4.15). The average member age was 40.71 years (*SD* = 11.48), and 57% were male. Almost all team members (98.7%) had a vocational qualification or higher. Among team supervisors, the average age was 47.31 years (*SD* = 9.71), 71% were male, and all had a vocational qualification or higher. Supervisors' average team tenure was 5.13 years (*SD* = 5.95).

Table 4.2

Description of teams and tasks in the sample

Type of team	Description of specific tasks	# Teams
Healthcare (5)	Special care for disabled patients	1
	Treating (cardiology) patients	3
	Vaccination, screening, and treatment of patients with sexually transmitted diseases	1
Sales (4)	Selling – dairy products, distribution techniques, cars, and flexible foils	4
Management (11)	Managing day-to-day operations of a restaurant chain	4
	Managing production processes and quality control	2
	Managing 15 tire centers	1
	Scheduling, planning, and coordinating activities	4
Research and research support (6)	Conducting pharmaceutical research	1
	Analyzing the chemical processes and fermentation of waste materials	2
	Updating and clearing the national archives and making them accessible	2
	Reviewing and making decisions on grant proposals, monitoring granted projects	1
Administrative support: HR, legal, policy (7)	Recruiting and selecting employees, HR advice, personnel administration	3
	Administrative organization, quality control and support of staff	4
Educational (7)	Developing educational program for high school students	3
	Teaching elementary school children, and organizing remedial teaching	2
	Teaching and coaching of asylum seekers	1
	Team development and training for police officers	1
Finance (5)	Cost control and estimation, purchasing, and planning	4
	Managing retirement insurances	1
Consulting (7)	Financial and risk management of companies, providing advice to board members	2
	Supporting the board with developing their mission, strategy, and monitoring system	2
	Providing legal advice; monitoring adherence to legal regulations by companies	3
Engineering (10)	Directing the production of airplane components and assessing their quality	2
	Realizing the detailed design of wind turbines	1
	Building and testing mobile banking applications for the iPhone and iPad, using Android	3
	Maintenance of computers, technical services, and software solutions	2
	Designing, building, testing, and implementing telecommunication products	2
Marketing (4)	News selection & script writing, field marketing; promoting, planning, & organizing mktg. activities	4
Other (9)	Purchasing oil and gas	1
	Monitoring facility management activities; maintenance planning and execution	4
	Social security-related services and activities	4
	TOTAL:	**75**

Measures

Influence hierarchization and centralization. Influence hierarchization and centralization were measured using a dyadic rating approach. Specifically, participants were given the names of all members of their team (excluding their supervisor) and were asked to respond to the following question: "To what extent does each of the following persons exercise influence over you?" (1 = *not at all*; 2 = *somewhat*; 3 = *to a large extent*). Given that only 14% of respondents marked "to a large extent" whereas 46% marked "somewhat", we collapsed these categories in order to create a dichotomous variable in which 0 = "*not at all*" and 1 = "*somewhat*" or "*to a large extent*".

We used responses to this question to create a sociomatrix in which matrix element x_{ij} represents member i's assessment of whether member j has any influence over him or her. We then computed hierarchization using Krackhardt's (1994; Everett & Krackhardt, 2012) network hierarchy measure. Network hierarchy is measured as 1 – [v / max(v)], where v is the number of pairs in the network where influence is symmetric (A influences B and B influences A, directly or through other members) and max(v) is the total number of connected pairs (A influences B or B influences A). Hierarchy values can range from 0 (all connected pairs have symmetric influence) to 1 (all connected pairs have asymmetric influence).

We computed influence centralization using Freeman's (1979) centralization index, $\sum(c_{max}-c_i) / (n-1)^2$, where c_i is each member's influence centrality score, c_{max} is the highest influence centrality score within the team, and n is the number of team members. Influence centrality for each member (c_i) was computed as the number of other team members who indicated that a given team member had influence over them. Centralization ranges from 0 (all members have equal influence) to 1 (one member has influence over all others who have influence over no one).

Task complexity. Task complexity was measured with eight items adapted from Withey et al. (1983). Sample items include: "We follow an understandable sequence of steps in performing our team tasks"; "We use established procedures and practices to perform our team tasks"; "The tasks of our team are very routine"; and "There is a clearly known way to do the major types of work we normally encounter". We measured these eight items on a seven-point scale (1 = *strongly disagree*, 7 = *strongly agree*), and reverse-coded them to form a global measure of task complexity for each team member. Cronbach's alpha for the eight-item scale was .81, and aggregation statistics supported aggregation to the team-level (ICC_1 = .37; ICC_2 = .79; $F(74,387) = 4.72$, $p < .001$); the median $r_{wg(j)}$ value using a uniform expected variance distribution was .93 (*SD* = .06) (James, Demaree, & Wolf, 1984).

Process conflict. Process conflict was measured with three process conflict items from Shah and Jehn (1993): "To what extent are there disagreements about who should do what in your work team?"; "To what extent is there conflict in your work team about task responsibilities?"; and "To what extent do you disagree about resource allocation in your work team?" (1 = *to a small extent*, 7 = *to a large extent*). Cronbach's alpha for the combined three-item scale was .82, and aggregation statistics supported aggregating to the team-level (ICC_1 = .14; ICC_2 = .52; $F(74,376) = 2.07$, $p < .001$;); the median $r_{wg(j)}$ value using a uniform expected variance distribution was .84 (*SD* = .21).

Team performance. Because our sample included a diverse set of work teams that pursued very different tasks and responsibilities, we used a broad measure of team performance as suggested by previous research (Ancona & Caldwell, 1992). Specifically, we asked each supervisor to compare the performance of the focal work team with that of relevant other work teams with similar composition, tasks, and customers on the following criteria: quality, effectiveness, work speed, meeting deadlines, and performance continuity. The response set

ranged from 1 (*far below average*) to 7 (*far above average*). Cronbach's alpha for the combined five-item scale was .84, suggesting that supervisors were evaluating an overall construct of team effectiveness.

Job satisfaction. Job satisfaction was measured with four items taken from Agho, Price, and Mueller's (1992) global satisfaction measure: "I find real enjoyment in my job; "I am never bored with my job"; "I feel fairly well satisfied with my job"; and "I would not consider taking another kind of job". Cronbach's alpha for the combined four-item scale was .91, and aggregation statistics supported aggregating to the team-level (ICC_1 = .13; ICC_2 = .50; $F(74,377) = 2.00$, $p < .001$); the median $r_{wg(j)}$ value using a uniform expected variance distribution was .92 (SD = .20).

Control variables. Influence hierarchization scores are inherently density-constrained; as density increases, the proportion of symmetric pairs increases, which reduces hierarchization. We therefore controlled for influence density in all analyses (average of all influence centrality scores within the team). Given that size varied considerably across work teams and we know that team size relates to cohesiveness and internal communication in groups, team size was also included as a control variable in all analyses (Ancona & Caldwell, 1992; Bantel & Jackson, 1989). We also ran our models with the following control variables: mean team tenure, age diversity, team tenure diversity, and gender diversity. Since none of these control variables affected the pattern of significant results, we do not include them in the final models reported in this paper, consistent with the recommendations of Becker (2005). Nevertheless, they are included in our correlation matrix.

RESULTS

Table 4.3 reports descriptive statistics and correlations for all study variables. We observed a positive and significant correlation between centralization and process conflict

(r = .24, p < .05) and a negative and significant correlation between hierarchization and process conflict (r = -.30, p < .01), as we would expect given Hypotheses 1 and 2. We also observed a strong correlation between hierarchization and density (r = -.70, p < .01), and a modest but significant correlation between hierarchization and team size (r = -.32, p < .01), underscoring the need to control for these two variables in our analyses. Hierarchization and centralization were weakly correlated (r = .22, *n.s.*).

Table 4.4 reports the results of regression analyses examining the main and/or interactive effects of hierarchization and centralization on process conflict (Model 1), group performance (Model 2), and member satisfaction (Model 3). Hypotheses 1 and 2 predicted that hierarchization would be negatively and centralization positively related to process conflict. The results reported in Model 1 of Table 4.4 are consistent with these predictions, with a negative and significant coefficient for hierarchization (B = -.47, p < .001) and a positive and significant coefficient for centralization (B = .19, p < .05). Hypotheses 3 and 4 predicted that both of these effects would be amplified in groups that perform more complex tasks. This prediction was supported in the case of centralization (Hypothesis 4) but not hierarchization (Hypothesis 3). Specifically, whereas the interaction between hierarchization and task complexity did not significantly predict process conflict (B = -.06, *n.s.*), the interaction between centralization and task complexity was a significant predictor (B = .20, p < .05). A plot of this interaction (see Figure 4.2) provides further insight into the nature of the effect. Whereas centralization is essentially unrelated to process conflict when task complexity is low, it becomes strongly associated with conflict when task complexity is high.

Table 4.3

Descriptive statistics and correlations

Variables	*Mean*	*SD*	1	2	3	4	5	6	7	8	9	10	11
1. Mean team tenure[a]	47.60	30.90											
2. Age diversity	0.20	0.09	.23*										
3. Team tenure diversity	0.66	0.31	.16	.17									
4. Gender diversity	0.29	0.20	-.02	-.01	-.16								
5. Team size	6.47	2.22	.02	.09	.14	.17							
6. Influence density	0.56	0.19	.01	.01	-.17	-.07	-.02						
7. Influence hierarchization	0.41	0.36	-.07	-.13	.07	.01	-.32**	-.70**					
8. Influence centralization	0.41	0.21	-.09	.00	.01	.20	-.14	-.13	.22				
9. Task complexity	4.20	0.69	-.07	.19	.00	.07	-.07	.28*	-.10	-.02			
10. Process conflict	4.41	0.36	.05	.14	-.14	.17	-.05	.17	-.30**	.24*	.15		
11. Group performance	5.15	0.76	-.15	.09	.02	-.05	.07	.13	-.08	.01	.25*	-.15	
12. Member satisfaction	5.23	0.79	.19	.18	.07	-.14	.01	-.02	.11	-.20	.04	-.36**	.05

Note. N = 75. * $p < .05$, ** $p < .01$, *** $p < .001$. [a] In months.

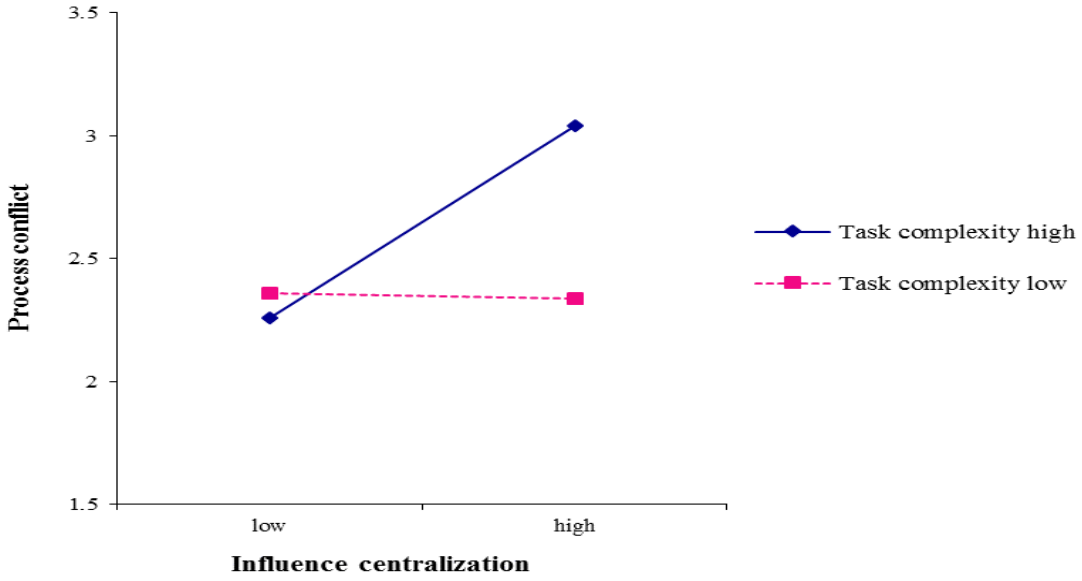
Table 4.4

Regression results: Process conflict, group performance, and member satisfaction

Predictor	Model 1 *Process conflict*	Model 2 *Group performance*	Model 3 *Member satisfaction*
Covariates			
Team size	-.13 (.08)	.03 (.10)	.01 (.08)
Influence density	-.18 (.10)	-.01 (.13)	.05 (.11)
Independent variables			
Influence hierarchization	-.47 (.11)***	-.22 (.16)	.09 (.13)
Influence centralization	.19 (.08)*	.06 (.10)	-.11 (.08)
Moderator			
Task complexity	.15 (.07)*	.27 (.09)**	.04 (.08)
Interactions			
Influence hierarchization * Task complexity	-.06 (.07)	-.00 (.09)	.06 (.08)
Influence centralization * Task complexity	.20 (.08)*	.25 (.10)*	-.01 (.08)
Mediator			
Process conflict		-.39 (.15)*	-.28 (.12)*
Model F	4.33***	2.07~	1.64
R^2	.31	.20	.17

Note. N = 75. Unstandardized regression coefficients are presented.
Standard errors in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$, ~ $p = .051$.

Figure 4.2 *The moderating effect of task complexity on the relationship between influence centralization and process conflict*



Hypotheses 5 through 8 predicted that hierarchization and centralization would have indirect effects on both performance and satisfaction through process conflict. Results are presented in Models 2 and 3 of Table 4.4. After controlling for the main and task-contingent effects of hierarchization and centralization, process conflict was negatively related to both performance and satisfaction in these teams (B = -.39, p < .05 and B = -.28, p < .05 respectively). We examined the significance of the (conditional) indirect effects predicted in Hypotheses 5 through 8 using the bootstrapping procedures recommended by Preacher, Rucker, and Hayes (2007). Results are summarized in Table 4.5. We predicted that hierarchization and centralization would have indirect effects on group performance and member satisfaction through their effects

on process conflict. We found that the indirect effect of hierarchization on both performance and satisfaction was positive and significant at all levels of task complexity (i.e., 95% bias corrected and accelerated confidence intervals did not include zero). We also found that the indirect effect of centralization on both performance and satisfaction was negative and significant only when task complexity was at average or high levels, consistent with our earlier finding. These results provide support for Hypotheses 5-8.

Table 4.5

Bootstrap results for conditional indirect relationships

Group performance						
Task complexity	Effect hierarchization	BCA-L95	BCA-U95	Effect centralization	BCA-L95	BCA-U95
Low	.16	.04	.37	.00	-.12	.10
Average	.19	.04	.42	-.08	-.19	-.003
High	.21	.03	.53	-.15	-.34	-.01
Member satisfaction						
Task complexity	Effect hierarchization	BCA-L95	BCA-U95	Effect centralization	BCA-L95	BCA-U95
Low	.12	.03	.29	.00	-.08	.06
Average	.13	.02	.30	-.05	-.18	-.01
High	.15	.02	.40	-.11	-.27	-.02

Note. Bootstrap N = 1,000. Bias corrected and accelerated (BCA) confidence intervals are reported. BCA-L95 = 95% confidence interval lower limit. BCA-U95 = 95% confidence interval upper limit.

Post Hoc Analyses

We conducted two post hoc analyses in order to establish the robustness of these results[11]. First, in order to bound our analysis, we focused our formal model and empirical test on comparing hierarchization with centralization rather than steepness, since centralization is the more common conceptualization. Nevertheless, we did conduct post hoc analyses in which we re-ran our models using steepness (i.e., the standard deviation of peer-rated influence within the

[11] Exact results from these post hoc analyses can be obtained by contacting the author.

team) in place of centralization. Steepness and centralization were correlated at .73 in this sample of teams ($p < .001$), slightly larger than in our earlier analysis of hypothetical teams ($r = .63$). Moreover, replacing centralization with steepness in our analyses resulted in a very similar pattern of significant results. Steepness was positively related to process conflict ($p < .05$) whereas hierarchization was negatively related to process conflict ($p < .001$), and the indirect effect of steepness on performance and satisfaction was negative and significant but only when task complexity was moderate to high. The interactive effect of hierarchization and task complexity on process conflict did not achieve significance, however. Notably, steepness had a direct negative effect on satisfaction ($p = .051$) whereas centralization did not. In short, steepness and centralization had largely convergent effects in this sample of teams.

Second, we focused on process conflict as the mediator in our model given that process conflict is specifically concerned with conflicts related to the delineation of member roles, responsibilities, and relations – the very conflicts that we suggested could be resolved by hierarchization and exacerbated by centralization. As noted earlier, however, researchers have identified other forms of conflict – related to tasks, relationships, and status – which might also be affected by hierarchization and centralization. We therefore re-ran models with a) task conflict, b) relationship conflict, and c) status conflict as mediators in place of process conflict. Given the high correlation between these conflict variables, we ran separate models rather than one model with all conflict variables included. We found that hierarchization significantly reduced whereas centralization significantly increased each type of conflict ($p < .05$ in every case). We also found that task complexity significantly strengthened the negative effects of hierarchization on both relationship conflict ($p < .05$) and status conflict ($p < .05$), a contingent relationship which we had hypothesized but that was not supported in the case of process conflict. Only process conflict had significant direct and indirect effects on group performance.

DISCUSSION

The theory and results of this paper make at least three important contributions to the ongoing debate about the functions and dysfunctions of hierarchy in task groups. First, we build on ethological and social network traditions to advance a conceptualization of hierarchy as ordered (i.e., cascading) influence relations, and show that this view of hierarchy is both conceptually and operationally distinct from the way hierarchy is traditionally conceptualized in the group and organizational literature. Second, we demonstrate that hierarchy as ordered influence relations (i.e., influence hierarchization) has generally positive implications for a key group process (conflict) and key group outcomes, whereas hierarchy as inequality in member influence (e.g., influence centralization) has generally negative implications for those same process and outcome variables. And third, we provide important insights into the key role of task complexity as a moderator of these effects. We touch briefly on each of these contributions in this section, and conclude with a discussion of study limitations.

Hierarchy as Cascading Influence Relations

The growing literature on hierarchy in the group and organization literatures has been inconsistent in how hierarchy is conceptualized, and generally views any inequality in member power, prestige, or privilege as an indicator of hierarchy. A key contribution of this paper, therefore, is to demonstrate that not all indicators of intra-group power/status inequality necessarily imply that actual influence relations are hierarchically ordered. Most researchers who study hierarchy in the organizational literature implicitly agree that hierarchy matters because it affects influence relations. But rather than study dyadic relations directly, past research has assumed (often implicitly) that inequality in power, prestige, or privilege within a group suggests that dyadic relations are hierarchically structured because those lower on these dimensions will defer to those who score higher. We challenge this assumption by demonstrating that key

measures of power/status inequality – centralization and steepness – are conceptually and empirically distinct from actual dyadic hierarchization. Indeed, within this sample, the correlation between centralization and hierarchization was only .22, and between steepness and hierarchization was only .09.

In making this observation, we are, in fact, retracing ground that was covered in the ethological literature. Hierarchy has long been of central interest to researchers who study group-living animals. One key question within that literature is whether hierarchies – ordered relations of dyadic dominance – can be predicted by individual differences. Chase and colleagues (see Chase, 1980; Chase et al., 2002) have demonstrated that observed correlations between dyadic dominance and those individual characteristics that we would expect to predict dyadic dominance (e.g., size, aggressiveness) are simply not high enough to lead to more than modest linearity in dominance relations. Actual hierarchies must, therefore, be structured either by individual variables we have not yet considered, or by the group-specific and path-dependent outcomes of dyadic (and triadic) dominance contests. The assumption that inequality in power, prestige, or privilege will predict dyadic influence is therefore suspect.

In operationalizing hierarchy, we built directly on research by Krackhardt (1994) on the nature of hierarchy in social networks. It is therefore important to note that the concept of network hierarchy is just one of four dimensions that Krackhardt proposed to determine whether a network resembles a tree structure. In addition to network hierarchy, he suggested that a true out-tree structure requires that a) every actor connects to the network ("connectedness"), b) every actor is influenced by just one other actor ("efficiency"), and c) every pair of actors has at least one common root ("least upper boundedness"). Because we are specifically interested in the hierarchical ordering of intra-group influence relations and not on whether a group's influence network fully resembles a tree structure, we did not consider these other dimensions in our

analysis. Nevertheless, we did examine them separately. We found no meaningful variance in connectedness or least-upper-boundedness in these teams. We did find variance in efficiency, but it was highly correlated with density, which was included in our analyses and did not have any significant effects on process or performance.

The Functions of Hierarchization and the Dysfunctions of Centralization

Several recent papers have suggested that hierarchy can have functional consequences for social groups, especially under certain circumstances (see Anderson & Brown, 2010; Magee & Galinsky, 2008; Ronay et al., 2012; Simpson et al., 2012). But empirical examinations of this proposition have generated mixed results. Another key contribution of this paper is to suggest that this mixed pattern of results may be due to the fact that traditional conceptualizations and operationalizations of hierarchy do not directly get at the actual hierarchical ordering of influence relations and may, in fact, be capturing more dysfunctional forms of intra-group stratification. In other words, the results of this paper strongly reaffirm the functional benefits of hierarchy and suggest that the oft-cited ills of hierarchy may actually be due to inequality without hierarchization.

It is also significant that hierarchization was not just associated with team performance in this study, but that it also predicted team member satisfaction. Some researchers have admitted that hierarchy may have functional benefits, but suggest that these benefits come at a cost to team satisfaction and morale (Anderson & Brown, 2010). We find here that hierarchization can have a positive effect on member satisfaction by reducing conflict within a group. In contrast, centralization exacerbated these conflicts and therefore lowered member satisfaction. These results suggest, once again, that the dysfunctions ascribed to hierarchy may, in fact, be dysfunctions resulting from inadequate hierarchization.

The idea that hierarchization is generally good for groups would seem to contradict past research showing that it is density in network relations – not hierarchy – that promotes performance and viability (e.g., Balkundi & Harrison, 2006). Density and hierarchization were strongly negatively correlated in our study and it was hierarchization – not density – that had positive effects. This result makes more sense when we recognize that the benefits of density have been observed with communication ties, whereas we focused on influence ties. We would agree that dense communication networks can be good for groups, especially when tasks are complex (Shaw, 1964). In fact, the ideal network structure for groups dealing with complex tasks may be a dense communication network combined with a hierarchical influence network.

The Moderating Role of Task Complexity

Finally, we found that the centralization of influence relations was more likely to lead to conflict in teams that performed complex tasks. In fact, in teams that scored low on task complexity, centralization had no effect on conflict (see Figure 4.2). This finding suggests that whereas centralized influence relations may be workable when tasks are simple and routine and a central member can therefore manage the few questions and exceptions that might arise, this approach becomes dysfunctional with complex tasks that require greater adaptation, problem-solving, and improvisation. This finding is consistent with past research on centralized communication networks (e.g., Leavitt, 1951), and suggests that similar dynamics play out with centralized influence networks.

We also expected to find that task complexity would strengthen the effect of hierarchization on process conflict, but that contingent effect was not statistically significant in our analyses. We did, however, find in our post hoc analyses that task complexity strengthened the effect of hierarchization on both relationship and status conflict. It is not obvious why task complexity would moderate the hierarchization-conflict relationship for status and relationship

conflict but not for process conflict. One possible explanation is that relationship and status conflicts tend to be more personal than process or task conflicts and that hierarchization is especially useful in ensuring that the uncertainty and intensity of complex tasks don't translate into personal forms of conflict. Regardless, the fact that task complexity did moderate the relationship between hierarchization and some forms of conflict suggests that our theoretical arguments about the moderating role of task complexity were not too far off the mark.

Study Limitations

Our study design has several notable strengths. For example, our data collection approach made it possible to collect data from a very diverse sample of teams. We collected data from different sources (members and supervisors) using different data collection and aggregation approaches (peer ratings and team assessments). Nevertheless, there are some aspects of our study design that could raise questions. For example, the fact that our measures were all collected at the same point in time raises the possibility that causality operates differently than we hypothesized. For example, one might ask whether conflict somehow leads to more centralized teams or less hierarchical teams. Although the theoretical arguments that would generate this alternative causal model are not obvious, the fact remains that we cannot eliminate alternative models of causality with these cross-sectional data.

Moreover, it would have been interesting to consider a broader range of mediating variables (e.g., information sharing, backup behaviors) or outcome variables (innovation, turnover, organizational citizenship behavior). And it would have been useful to compare our measures of influence hierarchization and influence centralization with stratification measures that are based on more objective measures of influence or on different expressions of influence (e.g., attitudinal influence). These questions raise important possibilities for future research.

Conclusion

We have demonstrated that a view of hierarchy as cascading relations of dyadic influence captures the functional benefits of hierarchy in teams whereas difference-based conceptualizations such as centralization and steepness capture its dysfunctions. The theory and results of this study therefore provide an important conceptual and operational toolkit to assist in our efforts as researchers to sort out the functions and dysfunctions of hierarchy in task groups.