

On Ladders and Pyramids: Hierarchy's Shape Determines Relationships and Performance in Groups

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Personality and Social
Psychology Bulletin
1–17
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DOI: 10.1177/0146167219842867
journals.sagepub.com/home/pspb



Abstract

Hierarchies take different forms, which individuals mentally represent using different geometric shapes. We propose and empirically demonstrate that individuals' mental representations of the shape hierarchy takes affect its consequences. Five studies compared two common mental representations of hierarchy shapes—ladders and pyramids—to explore whether, why, and how individuals' perceptions of hierarchy's shape undermine constructive relationships within groups and group performance. Study 1 demonstrated that individuals commonly mentally represent hierarchies as ladders and pyramids. In Studies 2 and 3, employees who perceived their workplace hierarchies to be shaped like ladders (as compared with pyramids) experienced worse intragroup relationships. Finally, Studies 4 and 5 experimentally manipulated groups' hierarchical shape in the lab and found that ladder-shaped hierarchies undermined social relationships and group performance relative to pyramid-shaped hierarchies. Taken together, these findings enhance our understanding of hierarchies' multifaceted consequences and help shed light on the (dis)utility of hierarchy for group functioning.

Keywords

group processes, hierarchy, trust, conflict and cooperation, performance

Received April 16, 2018; revision accepted February 24, 2019

... seat racing is very difficult to kind of come to terms with as a team. I don't think there's really a lot of other sports that pit teammates against each other this way, where one teammate's win is another teammate's loss. And there's kind of a ladder that's created, where this person is the top person on their side, and then this person, and then this person, and then this person. And I think some people internalize that as absolute ... they sort of treat people as they are ranked on the ladder. (Collegiate Rower; Halevy, 2018)

... in beach [volleyball] ... we have challenge matches, so everyone's ranked in a ladder ... playing each other head-to-head, I-won-you-lost, I'm-playing-you're-not ... that can be very counterproductive ... I think it's a tough thing about ladder sports ... (Collegiate Volleyball Player; Halevy, 2018)

Hierarchy is a ubiquitous form of social organization (Fiske, 2010; Magee & Galinsky, 2008). Whereas functional models of hierarchy suggest that hierarchy can help group functioning via improved coordination and cooperation (Halevy, Chou, & Galinsky, 2011), conflict perspectives on hierarchy suggest it often comes with social costs (Greer, Van Bunderen, & Yu, 2017). Indeed, a recent meta-analysis revealed that

hierarchy fuels destructive within-group conflicts, which eventually erode the performance benefits that hierarchy enables (Greer, de Jong, Schouten, & Dannals, 2018). Given the prevalence of hierarchy and its powerful impact on social interactions (e.g., Greer et al., 2018; Hays & Bendersky, 2015; Magee & Galinsky, 2008), it is critical to understand when and why hierarchy may damage social relations within groups and group performance.

The current research seeks to advance knowledge on the potential social costs of hierarchy in groups, thereby extending the conflict perspective on hierarchy (Greer et al., 2017) by exploring whether the way in which group members mentally represent the shape of their group's hierarchy (Gallistel, 2001) determines when hierarchy undermines social relations and hampers performance in groups. Specifically, we

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focus on two important hierarchy shapes, or geometrical forms, that people commonly use to mentally represent hierarchy: “ladders” and “pyramids.” Although hierarchy can potentially take other forms, given that this is the first research (to the best of our knowledge) to explore how lay perceptions of hierarchy shapes influence group processes and outcomes, contrasting these two most pervasive types of hierarchical shapes seems an adequate first step.

We suggest individuals commonly use ladder shapes (henceforth, ladders) to mentally represent hierarchical distributions that come with (a) salient vertical categorical distinctions between members in different ranks, (b) a narrow base and a relatively equally narrow top, and (c) in its most extreme form, a group structure in which each group member occupies a distinct rank in the hierarchy. In contrast, individuals commonly use pyramid shapes (henceforth, pyramids) to mentally represent hierarchical distributions in which (a) few group members control most of the group’s resources, (b) the lower ranks form a wider base and the higher ranks form a narrower top, and (c) in its extreme form, a group structure in which a single individual occupies the highest and all the other group members occupy the lowest rank in the hierarchy.

We propose that groups in which the hierarchy is represented as a ladder are more likely to experience dysfunctional social relations and reduced performance as compared with groups in which the hierarchy is represented as a pyramid. This is because the mental representation of a ladder highlights internal divisions between individuals within the group who occupy different hierarchical ranks—as exemplified by our opening quotes from interviews conducted with collegiate athletes. The greater salience of vertical differences between group members spurs social comparisons within groups, and subsequently diminishes the quality of social relationships within the group and erodes performance.

Ladders and Pyramids: Common Mental Representations of Hierarchies

Hierarchy, defined as the vertical differentiation among group members along one or more socially valued dimension(s), is a fundamental concept in the social sciences (e.g., Greer et al., 2018; Halevy et al., 2011; Hays & Bendersky, 2015; Magee & Galinsky, 2008). The vast majority of work has studied hierarchy by looking at structural inequality in the distribution of valued characteristics or outcomes within a group (Bunderson, Van Der Veegt, Cantimur, & Rink, 2016; Harrison & Klein, 2007).¹ Although previous research has provided many valuable insights on the functions and dysfunctions of hierarchy, one important limitation of extant work is that it typically treats hierarchy as a binary construct (e.g., by contrasting hierarchy with equality). Consequently, different views of hierarchy are often conflated, thereby making it difficult to know what is it about

hierarchy that undermines group processes and outcomes (Greer et al., 2018). Indeed, hierarchies take different forms and shapes and individuals may mentally represent them differently. Consequently, it remains unknown how different perceptions of hierarchical shapes influence group processes and performance. By addressing this question, we heed recent calls to explore the effects of different hierarchical configurations on group processes and outcomes (Bunderson et al., 2016; Greer et al., 2018).

We concentrate on two specific shapes that individuals may use to mentally represent their group’s hierarchy, namely, ladder and pyramid shapes, for two complementary reasons. First, these two shapes capture common ways in which people mentally represent and communicate about hierarchy. In organizational settings, about 25% of Fortune 500 companies use a linear forced-ranking system of pay grade (e.g., Intel, General Electric; Boyle, 2001). These ranking systems are commonly visualized as ladders. Pyramids similarly pervade organizational settings: In many organizational contexts (e.g., universities, governments, corporations), fewer positions exist the closer one gets to the top of the hierarchy (Gruenfeld & Tiedens, 2010). Finally, popular press articles such as “Climbing the Corporate Ladder: Whom to Impress? And How?” (Erickson, 2007) and “It’s Time to Invert the Management Pyramid” (Nayar, 2008) often reinforce people’s tendencies to mentally represent hierarchies as ladders and pyramids.

Second, these two shapes are meaningfully distinct in theoretically important ways. We propose that ladders and pyramids are common lay mental representations (i.e., “symbols isomorphic to some aspect of the environment”; Gallistel, 2001, p. 9691) of two key features of hierarchies identified in scholarly research—stratification and centralization. Ladders capture the lay mental representation of the abstract construct of hierarchical stratification (Bunderson & Van der Veegt, 2018), which achieves its maximum value when each member of the group occupies a distinct rank in the group’s hierarchy. Pyramids, however, capture the lay mental representation of the scholarly construct of hierarchical centralization (Bunderson & Van der Veegt, 2018), which achieves its maximum value when one member has the highest score (e.g., pay grade, job title) all other group members share the lowest score.

We focus here on the consequences of lay perceptions and experiences of these two key hierarchical shapes. Individuals think, feel, and act based on their mental representations of their environment (Gallistel, 2001). Considerable research in psychology highlights the “principle of construal” (e.g., Nisbett & Ross, 1991), that is, the notion that people’s interpretation of their objective circumstances gives rise to the psychologically active ingredients that then influence affect, cognition, and behavior (e.g., Rauthmann et al., 2014). Hence, to the extent that individuals commonly distinguish between pyramids and ladders and imbue these hierarchical

shapes with different meanings, examining these shapes will enhance our understanding of hierarchy's consequences.

Why and How Ladders and Pyramids Shape Social Relations in Small Groups

We propose that whether individuals mentally represent their group's hierarchy as a ladder versus a pyramid influences their propensity to engage in social comparisons, which, in turn, influences social relations within groups, and ultimately, group outcomes. Anecdotal evidence and psychological research suggest that people commonly associate ladders with social comparisons (Festinger, 1954; Garcia & Tor, 2009; Garcia, Tor, & Schiff, 2013). This is because in ladders (more so than in pyramids) individuals occupy distinct vertical ranks that emphasize internal divisions within a group (Garcia et al., 2013). This greater salience of vertical differentiation may compel members to continuously monitor who is at their rank, above them, or below them (Greer et al., 2018), and expend considerable mental effort thinking about both the antecedents of holding different ranks (i.e., why different members occupy lower vs. higher positions in the hierarchy relative to themselves as well as relative to each other) and the consequences of occupying different ranks (e.g., differential pay and authority; Lazear & Rosen, 1981).

Preoccupation with social comparisons within groups is likely to erode social relationships between members, as social comparisons often fuel competition for relative standing in the group (i.e., hierarchical conflict), which tends to be characterized by friction, hostility, and struggle (Bendersky & Hays, 2012; Greer et al., 2017; Neeley, 2013). That is, instead of thinking about how to support one another and achieve the group's common goal, members of ladders constantly compare themselves against one another and think about how they can secure and enhance their position in the ladder compared with those in their group. Indeed, researchers have found that preoccupation with rank (that can be caused by salient distinct ranks; Greer et al., 2017) promotes self-centered and deceptive behavior (Pettit, Doyle, Lount, & To, 2016) and competitive intragroup power struggles (Van Bunderen, Greer, & Van Knippenberg, 2018). This focus on protecting one's rank against possible encroachments diminishes the quality of relationships among members of ladders.

Consistent with these ideas, research shows that members of ladders tend to experience lower levels of positive intragroup relationships (e.g., Harbring & Irlenbusch, 2011). For example, exposure to a ladder-like system (i.e., tournament) in one task has been shown to reduce trust in one's counterpart during a subsequent, unrelated dyadic interaction (Harbring & Irlenbusch, 2011). Similarly, incentive systems that create ladder tournaments with high reward spreads have been demonstrated to crowd out voluntary cooperation (Bloom, 1999). Last, a positive association has been found

between concerns with relative standing, which we propose is a common feature of ladders, and aggression within groups (Neeley, 2013).

Finally, we propose that the dysfunctional social relationships that ladders produce will be detrimental for group performance. Positive social relationships help fulfill individuals' fundamental relatedness needs, a precondition for high levels of intrinsic motivation (Ryan & Deci, 2000a). Considerable research lends support to this idea. For example, De Jong and Elfring (2010) found that better social relations within tax consulting groups, operationalized as higher levels of trust within the group, led to greater effort and enhanced group performance. In contrast, intragroup power struggles and status conflicts, a marker of dysfunctional social relationships within a group, hinder group performance (Bendersky & Hays, 2012; Greer et al., 2017). To summarize, we expect ladder hierarchies to be more detrimental for group processes and outcomes than pyramids because ladders highlight internal divisions in groups, thereby spurring intragroup social comparisons that undermine positive relationships and, ultimately, reduce group performance.

Study 1: The Ubiquity of Ladders and Pyramids

In Study 1, we explored the extent to which individuals commonly represent hierarchy in their mind as a ladder and/or as a pyramid. We further explored how individuals' lay mental representations of hierarchical shapes relate to features of hierarchies identified by scholars, namely, stratification and centralization (Bunderson & Van der Vegt, 2018).

Method

Participants. We recruited 345 U.S. working adults (51% female; $M_{\text{age}} = 33.9$, $SD_{\text{age}} = 8.7$; 74.5% White, 11.6% African American, 8.7% Asian, 5.2% Others) from a nationwide participant pool maintained by a West Coast university. Participants received US\$2 as compensation for their time.

Design and procedure. Participants were randomly assigned to one of three experimental conditions (ladder, pyramid, or control). In all three conditions, participants were asked to indicate the shape that best reflects how they think about hierarchy. In the baseline control condition, participants completed this task without receiving any additional information about the nature of the hierarchy. Specifically, they were asked to choose which of the four simple shape terms adequately captures how they think about the concept of "group hierarchy": "pyramid," "ladder," "circle," and "square." The order in which the four choice alternatives were presented was randomized for each participant. The circle and square options were added based on previous research that utilized them to visually represent equality

(Zitek & Tiedens, 2012) and a highly steep hierarchy (Bunderson et al., 2016), respectively.

Participants in the ladder and pyramid conditions received the same instructions as participants in the control condition. Specifically, participants learned about an organizational setting in which employees can potentially occupy five different ranks. Participants in the ladder condition then read about a five-person work group in which each employee occupied a different rank, thereby illustrating the maximum stratification in the current context (Bunderson & Van der Vegt, 2018). Participants in the pyramid condition read about a five-person work group, with one person occupying the top rank and the remaining four occupying the bottom rank, thereby illustrating maximum centralization (Bunderson & Van der Vegt, 2018). Participants in both the ladder and pyramid conditions could then choose which of the four aforementioned shapes best captures the kind of hierarchy presented to them.

To monitor participants' attention to the information presented to them, participants were asked to recall whether the statement "the work group I was asked to consider had 7 employees in it" is true, false, or whether they had not been presented with a particular work group. Forty-two participants failed this attention check and were thus excluded from our analyses. Results are essentially the same without this exclusion. At the end of the survey, participants were asked to indicate which of the four shapes best represents the group hierarchy in their own workplace.

Results

The prevalence of ladders and pyramids. We first investigated whether people choose ladders and pyramids more than alternative shapes as reflective of their mental representations of group hierarchy in the baseline control condition. As expected, most participants chose either "pyramid" (69.44%, $N = 50$) or "ladder" (26.39%, $N = 19$), and only few chose "circle" (2.78%, $N = 2$) or "square" (1.39%, $N = 1$), suggesting pyramid and ladder shapes are indeed the two most common mental representations people have of group hierarchy.

Lending further support to this conclusion, when asked about their workplace hierarchy, the majority of participants also choose either "pyramid" (47.68%, $N = 144$) or "ladder" (35.43%, $N = 107$) as the most adequate representation of their real-world work group's hierarchy, with only 10.93% ($N = 33$) choosing "circle" and 5.96% ($N = 18$) choosing "square." These findings confirm the ubiquity of ladder and pyramid shapes in people's mental representations of organizational hierarchy.

Effects of group structure on endorsement of hierarchy shapes. We then tested whether participants were more likely to choose a ladder to describe the highly stratified group (ladder condition) and a pyramid to describe the highly centralized group (pyramid condition), rather than the other way around. Indeed, most of the participants who read about the highly stratified group in which exactly one group member

occupied each rank in the hierarchy chose ladder (71.3%, $N = 82$) to represent the group's hierarchy (pyramid: 20%, $N = 23$; circle: 5.22%, $N = 6$; square: 3.48%, $N = 4$). In contrast, most of the participants who read about the highly centralized group in which one member occupied the top rank and all other members occupied the bottom rank chose pyramid (62.93%, $N = 73$) to represent the group's hierarchy (ladder: 29.31%, $N = 34$; circle: 5.17%, $N = 6$; square: 2.59%, $N = 3$). Ladder choices were significantly more common in the ladder condition than in the baseline condition ($\chi^2 = 35.96$, $p < .001$) and the pyramid condition ($\chi^2 = 40.74$, $p < .001$). In contrast, pyramid choices were significantly more common in the pyramid condition than in the ladder condition ($\chi^2 = 43.82$, $p < .001$) and equally common in the pyramid and baseline conditions ($\chi^2 = 0.83$, $p = .36$).

Discussion

Study 1 found that people generally think of both abstract hierarchies and their own workplace hierarchies either as a pyramid or as a ladder. Moreover, their propensity to endorse each of these common shapes is directly related to features of hierarchies identified in previous scholarly research on organizational structures (i.e., stratification and centralization). Study 1 thus provides initial evidence that ladders and pyramids constitute common mental representations of organizational hierarchy, and that they correspond in theoretically predictable ways to existing scholarly measures of different hierarchical features, namely, stratification and centralization.

Study 2: Hierarchical Shapes and Workplace Relationships

Study 2 extended Study 1 by exploring the association between mental representations of hierarchy and employees' workplace experiences. Specifically, participants indicated how much their real-world workplace hierarchy resembles a ladder and a pyramid and responded to questions about the quality of their social relations at work.

Method

Participants. We recruited 380 U.S. working adults (65.3% female; age: $M = 35.0$ years, $SD = 9.3$; 71.3% White, 13.2% African American, 6.6% Asian, 8.9% Others; 80.8% participants with college or higher degree; median income level = US\$80,000-US\$89,999) from a nationwide participant pool maintained by a West Coast university. Participants received US\$5 as compensation for their time. No observations were excluded from the analyses.

Measures

Hierarchy shapes. Participants saw two figures, one representing a ladder and the other representing a pyramid (Figure 1), and indicated how similar the structure of their own

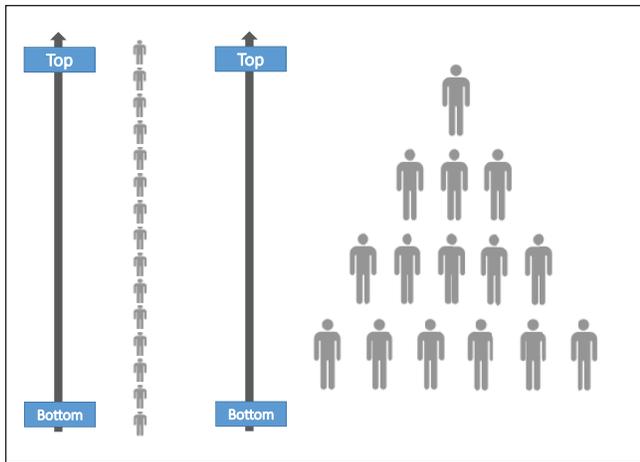


Figure 1. An illustration of ladder and pyramid.

work group is to each of the two shapes using scales ranging from 1 = *not at all similar* to 7 = *very similar*. The extent to which participants' work group was similar to a ladder correlated negatively with the extent to which it was similar to a pyramid ($r = -.23, p < .01$).

Social relationship quality. We triangulated across multiple scales to measure various aspects of participants' social relationship quality at work.

First, we measured the extent to which participants felt that their relatedness needs are satisfied at work (Ryan & Deci, 2000b). Participants completed the 21-item Basic Need Satisfaction Scale (La Guardia, Ryan, Couchman, & Deci, 2000). This measure included our target variable, relatedness need satisfaction (e.g., "I really like the people I work with"; $\alpha = .83$; 7-point scales: 1 = *not at all true* to 7 = *very true*), as well as satisfaction of two other basic needs, namely, autonomy and competence, which we administered for the sake of completeness.

Second, participants indicated the extent to which they felt socially supported at work. This five-item measure captures the degree to which employees feel that others care about their well-being and that their socioemotional needs are fulfilled (e.g., "My group is willing to help me if I need a special favor"; $\alpha = .87$; 7-point scales: 1 = *strongly disagree* to 7 = *strongly agree*; Eisenberger, Huntington, Hutchison, & Sowa, 1986).

Third, participants indicated their experiences of intra-group hierarchical conflict at work. This measure assesses the extent to which within-group competition for power and influence strains social relationships within the work group. Participants completed multiple items assessing hierarchical conflict, including six items that focus on power struggles adapted from Greer and Van Kleef (2010; e.g., "In my team, there are disagreements about who has control"; $\alpha = .95$) and six items that focus on status conflict adapted from Bendersky and Hays (2012; e.g., "my team members

experience conflicts due to members trying to assert their dominance"; $\alpha = .95$). Response scales ranged from 1 = *strongly disagree* to 7 = *strongly agree*. As these two measures were highly correlated ($r = .94, p < .01$), we averaged participants' responses to create a single index of hierarchical conflict.

Finally, an exploratory factor analysis with promax rotation showed that the three indicators of social relationship quality (relatedness needs satisfaction, social support, and reverse-coded hierarchical conflict) were highly intercorrelated and loaded on a single factor (eigenvalue = 2.13, 70.97% variance explained). We therefore developed a composite measure by averaging standardized scores of the three indicators ($\alpha = .79$). We report below results for each of our measures of relationship quality and the overall composite measure.

Control variables. Finally, given that a number of demographic characteristics could potentially influence relationship quality at work, especially gender and age (e.g., Wright & Bonett, 1997), we controlled for those in our analyses. Results are essentially similar without these controls.

Results

Table 1 presents the means, standard deviations, and correlations among Study 2's variables.

We regressed our measures of social relationship quality on participants' ratings of the extent to which their work group hierarchy was similar to a ladder and a pyramid as well as the control variables. As Tables 2 to 5 show, the more employees' work group hierarchy resembled a ladder, the higher were their experiences of hierarchical conflict, Table 4, Model 4: $\beta = 0.43, t(375) = 8.95, p < .01, \eta^2 = .18$, and the lower were their relatedness needs satisfaction, Table 2, Model 4: $\beta = -0.25, t(375) = 4.88, p < .01, \eta^2 = .06$, social support, Table 3, Model 4: $\beta = -0.11, t(375) = 2.02, p = .04, \eta^2 = .01$, and overall relationship quality (i.e., the global index), Table 5, Model 4: $\beta = -0.31, t(375) = 6.20, p < .01, \eta^2 = .09$, above and beyond the group's similarity to pyramid and control variables. We did not find any relationship between the extent to which individuals' workplace hierarchies resembled a pyramid and our measures of relationship quality (Model 4 in Tables 2-5; relatedness needs satisfaction: $\beta = 0.01, t(375) = 0.11, p = .91, \eta^2 < .01$; social support: $\beta = 0.05, t(375) = 0.98, p = .33, \eta^2 < .01$; hierarchical conflict: $\beta = 0.07, t(375) = 1.52, p = .13, \eta^2 = .01$; relationship composite: $\beta = -0.01, t(375) = 0.12, p = .90, \eta^2 < .01$). The negative effect of similarity to ladder on social relationship quality was significantly stronger than the effect of similarity to a pyramid (relatedness needs satisfaction, $F(1, 375) = 12.13, p < .01$; social support, $F(1, 375) = 5.20, p = .01$; hierarchical conflict, $F(1, 375) = 23.33, p < .01$; and relationship composite, $F(1, 375) = 19.82, p < .01$).

Table 1. Descriptive Statistics of Study 2 ($N = 380$).

Variables	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. Similarity to ladder	2.58	1.73	—						
2. Similarity to pyramid	5.53	1.34	-.23**	—					
3. Female	0.65	0.48	-.09 [†]	.03	—				
4. Age	34.97	9.32	-.06	.11*	-.06	—			
5. Relatedness need satisfaction	5.12	1.01	-.26**	.07	.11*	.04	—		
6. Social support from the group	5.35	1.13	-.13*	.08	.10 [†]	.02	.71**	—	
7. Intragroup hierarchical conflict	2.86	1.70	.42**	-.03	-.16**	-.03	-.54**	-.44**	—
8. Relationship quality composite	0.00	0.84	-.32**	.07	.14**	.04	.89**	.85**	-.78**

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

Table 2. Ordinary Least Squares Regression Results in Study 2 ($N = 380$).

Variables	Relatedness needs satisfaction			
	Model 1	Model 2	Model 3	Model 4
Similarity to ladder	-.026**		-.026**	-.025**
Similarity to pyramid		0.07	0.01	0.01
Female				0.09 [†]
Age				0.04
R^2	.07	.01	.07	.08

Note. Standardized beta coefficients.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

Table 3. Ordinary Least Squares Regression Results in Study 2 ($N = 380$).

Variables	Social support from the group			
	Model 1	Model 2	Model 3	Model 4
Similarity to ladder	-.013*		-.011*	-.011*
Similarity to pyramid		0.08	0.05	0.05
Female				0.09 [†]
Age				0.02
R^2	.02	.01	.02	.03

Note. Standardized beta coefficients.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

Discussion

Study 2 utilized employees' existing, real-world work groups as a research context. Study 2's findings lend support to our theorizing by showing that the more employees mentally represented the hierarchy in their work group as a ladder, the lower was the quality of social relationships they experienced in their work group. We did not find these negative effects for employees who perceived their work group as similar to a pyramid. Although it is often challenging to explain null effects, one possibility is that, because hierarchies can have both positive and negative effects, these opposite effects may

Table 4. Ordinary Least Squares Regression Results in Study 2 ($N = 380$).

Variables	Intragroup hierarchical conflict			
	Model 1	Model 2	Model 3	Model 4
Similarity to ladder	0.42**		0.44**	0.43**
Similarity to pyramid		-0.03	0.07	0.07
Female				-0.12**
Age				-0.02
R^2	.18	.00	.18	.20

Note. Standardized beta coefficients.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

Table 5. Ordinary Least Squares Regression Results in Study 2 ($N = 380$).

Variables	Relationship quality composite			
	Model 1	Model 2	Model 3	Model 4
Similarity to ladder	-.032**		-.032**	-.031**
Similarity to pyramid		0.07	-0.00	-0.01
Female				0.12*
Age				0.03
R^2	.10	.01	.10	.12

Note. Standardized beta coefficients.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

have counteracted one another in pyramids, resulting in an overall null association between pyramids (but not in ladders, in which the negative effects plausibly outweigh the positive effects). This possibility is consistent with the findings of a recent meta-analysis, which showed that hierarchies can have positive as well as negative effects on group processes and performance, and that the net effect of hierarchies is therefore quite small (Greer et al., 2018). Another possibility is that the absence of associations between similarity to pyramids and our outcome measures in Study 2 reflects the particular visualizations used in Study 2 as stimuli.

Study 2 is not without limitations. The correlational nature of our data in Study 2 leaves open the possibility that unobserved variables have produced a spurious association by affecting both the propensity to structure work groups as ladders and social relations within groups. In addition, the observed effects may be products of the specific visualizations we used as stimuli in Study 2. Studies 3 to 5 used different methodologies to address these limitations. Specifically, Study 3 used multisource field data from members of intact groups to assess the relations between hierarchy shape and social relations within work groups, and Studies 4 and 5 employed experimental designs in controlled laboratory settings.

Study 3: Hierarchy Shapes, Social Comparison, and Trust in Organizational Groups

Study 1 showed that people mentally represent highly stratified hierarchies as ladders and highly centralized hierarchies as pyramids, and Study 2 showed that ladders, but not pyramids, correlate negatively with the quality of social relationships at work. Building on these findings, Study 3 explored how organizational contexts that give rise to mental representations of pyramids or ladders—groups' hierarchical distributions which are either stratified or centralized—affect social comparison tendencies (Garcia & Tor, 2007) and relationship quality (e.g., intragroup trust; De Jong & Elfring, 2010) in work groups.

Method

Participants. Our sample included 221 preexisting work groups drawn from two Dutch financial corporations. The first sample (from the first organization) consisted of 90 work groups (593 employees; 30.02% female; $M_{\text{age}} = 44.78$, $SD_{\text{age}} = 10.6$; $M_{\text{size}} = 7.86$, $SD_{\text{size}} = 3.09$). The second sample (from the second organization) consisted of 131 work groups (1,124 employees; 52.98% female; $M_{\text{age}} = 42.85$, $SD_{\text{age}} = 9.42$; $M_{\text{size}} = 9.52$, $SD_{\text{size}} = 3.71$). Employees in both samples came from various departments in each organization, including marketing, human relations, and more.²

Measures. Study 3 utilized data from multiple sources. Relationship quality (Sample 1) and social comparison propensity (Sample 2) were reported by group members, whereas group performance was rated by managers (only available in Sample 2). Information on the shape of each group's hierarchy for both samples was based on employees' organizational rank (Sample 1: 1 = *lowest*, 10 = *highest*, based on formal rank; Sample 2: 1 = *lowest*, 15 = *highest*, based on salary scale), obtained from company human resource (HR) records.

Ladders. As discussed in Study 1, the mental representation of a hierarchical ladder comes from characteristics of the actual hierarchy's hierarchical stratification. Stratification captures the distribution of group members across the distinct categories of a socially valued dimension (e.g., rank). Stratification achieves its maximum value when every member occupies a distinct category along this vertical dimension. Therefore, we assess ladders by calculating group hierarchical stratification using the Blau (1977) index: $1 - \sum p_k^2$, where p is the proportion of group members in the k th rank (Bunderson & Van der Vegt, 2018).

Pyramids. As discussed in Study 1, the mental representation of a hierarchical pyramid relates to the characteristic of hierarchical centralization. Centralization captures the extent to which few group members score high on a socially valued dimension (e.g., rank), whereas all others score low on that dimension. Centralization achieves its maximum when one member scores at the highest level and all other group members score at the lowest level. Therefore, we assess pyramids by calculating group hierarchical centralization using the bias-corrected Gini coefficient: $\sum_{i=1}^N \sum_{j=1}^N |x_i - x_j| / 2n\bar{x}(n-1)$, where x_i is the rank for group member i of n total members and \bar{x} is the group mean rank (Biemann & Kearney, 2010).

Intragroup relationship quality (Sample 1 only). We measured group relationship quality with a five-item scale assessing intragroup trust developed by De Jong and Elfring (2010; e.g., "I trust my team members"; 1 = *strongly disagree* to 5 = *strongly agree*), which reflected sufficient internal consistency ($\alpha = .90$) and interrater agreement ($a_{\text{wg}} = .96$).

Intragroup social comparison propensity (Sample 2 only). We measured group members' propensity to engage in intragroup social comparisons with a four-item scale developed based on prior work on social comparison (Garcia & Tor, 2007, 2009; e.g., "I think about whether I am better or worse than my teammates"; 1 = *strongly disagree* to 5 = *strongly agree*; $\alpha = .92$; $a_{\text{wg}} = .88$).

Group performance (Sample 2 only). Each manager rated his or her group's performance with four items (e.g., "I believe this team performs well at work"; $\alpha = .85$; Greer, Caruso, & Jehn, 2011).³

Control variables. We also assessed the following variables, which have been found to affect group processes: *group size* related to intragroup processes (higher project labor; Staats, Milkman, & Fox, 2012) and negatively predicted group relationships in past research (Mueller, 2012); *percentage of female team members*, which has a positive effect on group performance (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010); and *age diversity*, which has been found to

Table 6. Descriptive Statistics of Study 3.

Variables	M	SD	1	2	3	4	5
Sample 1							
1. Ladder representation	0.52	0.21	—				
2. Pyramid representation	0.05	0.04	.53**	—			
3. Group size	6.59	2.91	.16	-.18 [†]	—		
4. Percentage of female	0.32	0.27	.08	.36**	-.18 [†]	—	
5. Age diversity	0.54	0.19	.23*	.11	.29**	.05	—
6. Relationship quality	4.00	0.31	-.13	.16	-.01	.09	-.05
Sample 2							
1. Ladder representation	0.38	0.18	—				
2. Pyramid representation	0.08	0.04	.60**	—			
3. Group size	9.57	3.68	-.34**	-.09	—		
4. Percentage of female	0.51	0.28	-.12	-.01	.21*	—	
5. Age diversity	0.58	0.15	-.16 [†]	-.09	.42**	-.05	—
6. Intragroup social comparison propensity	2.25	0.34	.10	-.06	.19*	.20*	.16 [†]

Note. $N = 90$ (Sample 1), $N = 131$ (Sample 2).

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

Table 7. Ordinary Least Squares Regression Results in Study 3.

Variables	Relationship quality (Sample 1)				Intragroup social comparison propensity (Sample 2)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Ladder representation	-0.13		-0.30*	-0.33*	0.10		0.21 [†]	0.35**
Pyramid representation		0.16	0.32*	0.35*		-0.06	-0.19 [†]	-0.24*
Group size				0.12				0.19
Percentage of female				0.01				0.21
Age diversity				-0.05				0.13
R^2	.02	.02	.09	.10	.01	.003	.03	.15

Note. $N = 90$, $N = 131$. Standardized beta coefficients.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

be negatively related to group identification and performance (Kearney, Gebert, & Voelpel, 2009). For age diversity, we grouped participants to 10-year cohorts (i.e., below 30, 30-39, 40-49, 50-59, and 60 or higher) and calculated the Blau index as in Boehm, Kunze, and Bruch (2014). To preclude the possibility that any relationship between hierarchy shapes and our criteria reflect these variables, we thus controlled for them in the analyses. Results are essentially similar without these controls.

Results

Table 6 presents the means, standard deviations, and correlations among Study 3's variables.

Ladders, pyramids, and relationship quality (Sample 1). We regressed relationship quality on the extent to which groups' hierarchy represented a ladder, a pyramid, as well as the control variables. As Table 7 shows, the more the group hierarchy was shaped like a ladder, the lower the group relationship quality, Model 4: $\beta = -0.33$, $t(84) = 2.52$, $p = .01$, $\eta^2 = .07$,

above and beyond similarity to pyramid and controls. In contrast, the more the group hierarchy was shaped like a pyramid, the higher the group relationship quality, Model 2: $\beta = 0.35$, $t(84) = 2.56$, $p = .01$, $\eta^2 = .07$, above and beyond similarity to ladder and controls. Further analysis revealed that ladders and pyramids each had unique effects on group relationship quality, in opposite directions, $F(1, 84) = 7.44$, $\text{Prob} > F = 0.01$.

Ladders, pyramids, intragroup social comparisons, and group performance (Sample 2). As shown in Table 7, the more the group hierarchy was ladder-like, the more group members tended to engage in intragroup social comparisons, Model 4: $\beta = 0.35$, $t(125) = 3.21$, $p < .01$, $\eta^2 = .08$, above and beyond similarity to pyramid and controls. In contrast, the more the group hierarchy was like a pyramid, the less team members tended to engage in intragroup social comparisons, Model 4: $\beta = -0.24$, $t(125) = 2.30$, $p = .02$, $\eta^2 = .04$, above and beyond similarity to ladder and controls. Further analysis revealed that ladders and pyramids each had unique impact on group members' propensity to engage in social

comparisons, in opposite directions, $F(1, 125) = 7.00$, $\text{Prob} > F = 0.01$.

Finally, we explored the possibility of an indirect effect of ladders, via the higher propensity to engage in intragroup social comparisons, on group performance. Although we did not find a significant main effect of ladders, $\beta = 0.02$, $t(102) = 0.12$, $p = .91$, $\eta^2 < .01$, or pyramids, $\beta = -0.04$, $t(102) = 0.28$, $p = .78$, $\eta^2 < .01$, on group performance, an indirect effect via an underlying mechanism may exist in the absence of a significant direct effect (Shrout & Bolger, 2002). Bias-corrected bootstrapping with 5,000 resamples revealed a significant indirect effect of ladders on lower group performance through elevated intragroup social comparisons (95% confidence interval [CI] = $[-0.70, -0.003]$). The indirect effect of pyramids on group performance via social comparisons was not significant (95% CI = $[-0.87, 2.06]$).

Supplementary analysis. For further robustness checks, see the supplemental material.

Discussion

Study 3 utilized a large sample of intact organizational work groups as a research context. These findings extend Studies 1 and 2 by showing that the more work groups' hierarchical structure was shaped like a ladder, the worse the relationships employees experienced—the less group members trusted each other and the more they compared themselves with one another. Moreover, such ladder-shaped hierarchies diminished team performance indirectly, via heightened intragroup social comparisons. Unlike Study 2, which did not find a positive effect of pyramids, Study 3 found that pyramids positively predicted relationship quality and negatively predicted team members' propensity to engage in social comparisons, consistent with the assertions of functionalist perspectives of hierarchy (e.g., Halevy et al., 2011).

Study 4: Hierarchy Shapes, Social Comparison, Relationship Quality, and Group Performance

Study 4 experimentally manipulated the hierarchical shapes of ladder and pyramid in a laboratory setting to explore how these shapes influence social relationships and group performance in a controlled environment.

Method

Participants. We recruited 213 individuals from a West Coast university to participate in an hour-long group decision-making study (61.0% female; age: $M = 22.5$ years, $SD = 5.50$; no ethnicity information collected). Each participant received US\$25 as compensation for their time. In addition, they had an opportunity to earn additional money as explained below.

Design and procedure. Participants arrived in the lab and were randomly assigned to three-person groups ($N = 71$ groups) and to roles within each group. Each group was escorted to a private breakout room and assigned to one of our experimental conditions. All the participants were informed that during the experiment, they would be working as part of a start-up team.

Study 4 employed a 2 (hierarchy shape: ladder vs. pyramid)⁴ \times 2 (functional role diversity: diverse vs. homogeneous), between-participants design. Participants in the ladder condition learned that their group has three hierarchical levels with one member in each level. The first member had the greatest equity share, influence, decision control, and responsibility in the start-up; the second had moderate levels of equity share, influence, decision control, and responsibility; and the third had the least equity share, influence, decision control, and responsibility. To further strengthen the manipulation of hierarchy structure, participants learned that the two best performing groups in the experiment will each receive a US\$300 prize. Specifically, if their group won the prize, members with the greatest equity share would get the largest share of the prize (US\$150), with the other two group members receiving US\$100 and US\$50, respectively.

In the pyramid condition, participants learned that their group has two levels with one member occupying the higher level and two members occupying the lower level. The first group member had greater equity share, influence, decision control, and responsibility in the start-up, and the other two members had lower levels of equity share, influence, decision control, and responsibility (that were identical between these two members). Similar to the ladder condition, we strengthened the hierarchical structure manipulation by notifying participants that if their group would win the performance-based prize, the member with the greater equity share would get the largest share of the prize (US\$150) and the two other members would receive US\$75.

We also manipulated the functional roles that participants held, to explore whether the predicted effects of hierarchy shape (i.e., ladder vs. pyramid) depend in any way on (i.e., interact with) the homogeneity versus differentiation within the group along other dimensions on which task groups differ (e.g., functional role). In the diversity condition, team members were randomly assigned to one of three roles: a finance expert, an education expert, and a social media expert. In the homogeneous condition, members were told they all possessed relevant knowledge and skills (i.e., generalists). We predicted a main effect of hierarchy shape that would generalize across the two levels of the functional role diversity factor. Given that functional role diversity did not interact with our main variable of interest (T6 in the supplemental material), we focus on the effect of hierarchy shape and treat functional role diversity as a control variable in the analyses.

Table 8. Descriptive Statistics of Study 4.

Variables	M	SD	1	2	3	4	5	6	7	8
1. Ladder hierarchy condition	0.51	0.50	—							
2. Functional role diversity condition	0.49	0.50	.01	—						
3. Percentage of female	0.61	0.31	.16	-.06	—					
4. Age diversity	0.31	0.24	-.30*	-.21 [†]	.13	—				
5. Intragroup social comparison propensity	3.96	0.97	.18	-.34**	.15	.26*	—			
6. Intragroup trust	5.72	0.77	-.20 [†]	.18	.09	-.14	-.45**	—		
7. Intragroup hierarchical conflict	2.03	0.86	.26*	.03	-.24*	.10	.31**	-.65**	—	
8. Relationship quality composite	-0.17	0.97	-.25*	.08	.18	-.13	-.42**	.90**	-.91**	—
9. Group performance	21.18	4.74	-.21 [†]	.17	.03	.16	-.04	.25*	-.25*	.27*

Note. $N = 71$ groups.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

Measures

All survey questions used 7-point scales ranging from 1 = *completely disagree* to 7 = *completely agree*.

Intragroup social comparison propensity. Participants responded to the same four items used to assess social comparison propensity in Study 3 ($\alpha = .91$, $a_{wg} = .69$).

Relationship quality. We again measured various aspects of participants' relationship quality in their task group. We first measured intragroup trust with five items as in Study 3 ($\alpha = .96$, $a_{wg} = .97$). Similar to Study 2, we also assessed hierarchical conflict, here with four of the items developed by Greer and Van Kleef (2010; e.g., "In my group, there were struggles about who had the most power," $\alpha = .91$, $a_{wg} = .97$). Intragroup trust correlated negatively with hierarchical conflict ($r = -.65$, $p < .01$). Therefore, we developed a relationship quality composite by averaging standardized scores of reverse-scored hierarchical conflict and intragroup trust.

Group performance. We assessed task performance using the number of correct answers to a logic puzzle. The puzzle consisted of 25 pieces of clues that needed to be arranged in the correct order. Hence, group performance scores could range from 0 to 25. Groups had 15 min to complete the puzzle task.

This task was developed by Greer et al. (2011) and is similar to traditional hidden-profile tasks (Stasser & Titus, 1985). Participants received pieces of information that they had to combine to create complete profiles of five venture funds (e.g., what industries they invest in, who is the founding partner). Each group member received the same number of clues and the same proportion of shared versus unshared clues as other group members. Group members had to share their unique information with each other to correctly solve the puzzle as a group.

We chose this task for two main reasons. First, this task captures a common decision-making procedure, whereby group members have different perspectives and pieces of

information that need to be integrated to make optimal group decisions (Kahneman, Slovic, & Tversky, 1982). Second, the objective outcome of this task offers a reliable performance measure (McGrath, 1984).

After the 15 min, each individual was led to a private cubicle with a computer terminal and completed a posttask questionnaire. All the participants were subsequently debriefed, thanked, and dismissed.

Controls variables. As in Study 3, we controlled for the proportion of females in the work group, age diversity (using Blau's index, age categories: below 20, 20-30, higher than 30), and the experimentally manipulated level of functional role diversity (1 = functional diversity group, 0 = functional homogeneity group). All these factors have previously been linked to group processes. Results are essentially similar without these controls.

Results

Table 8 depicts the means, standard deviations, and correlations among Study 4's variables.

Intragroup social comparison propensity. As shown in Table 9, groups assigned to the ladder condition reported engaging in social comparisons significantly more than groups in the pyramid condition, Model 1: $\beta = 0.26$, $t(66) = 2.20$, $p = .03$, $\eta^2 = .07$.

Relationship quality. As shown in Table 9, groups assigned to the ladder condition reported significantly worse relationship quality—they reported lower levels of intragroup trust, Model 2: $\beta = -0.29$, $t(66) = 2.39$, $p = .02$, $\eta^2 = .08$, and higher levels of intragroup hierarchical conflict, Model 2: $\beta = .40$, $t(66) = 3.37$, $p < .01$, $\eta^2 = .15$, resulting in overall lower scores on relationship quality composite, Model 3: $\beta = -.38$, $t(66) = 3.20$, $p < .01$, $\eta^2 = .13$.

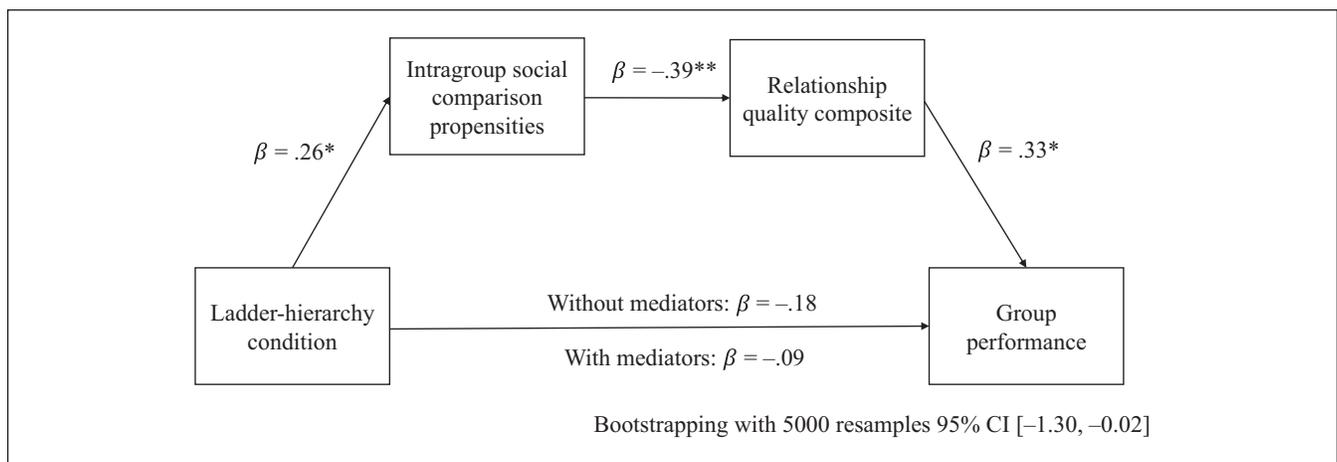
Indirect effect on group performance. Although the ladder condition had a marginally significant negative correlation with

Table 9. Ordinary Least Squares Regression Results in Study 4.

Variables	Intragroup social comparison propensity	Intragroup trust	Intragroup hierarchical conflict	Relationship quality composite
	Model 1	Model 2	Model 3	Model 4
Ladder hierarchy condition (1 = ladder, 0 = pyramid)	0.26*	-0.29*	0.40**	-0.38**
Functional role diversity condition (1 = yes, 0 = no)	-0.28*	0.15	0.07	0.04
Percentage of female	0.06	0.17	-0.33**	0.28*
Age diversity	0.27*	-0.22 [†]	0.28*	-0.27*
R ²	.22	.13	.21	.19

Note. $N = 71$ groups. Standardized beta coefficients.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

**Figure 2.** Serial mediation analysis of Study 4.

Note. Standardized beta coefficients. CI = confidence interval.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

group performance ($r = -.21$, $p = .08$), that effect was not significant in the full regression model, $\beta = -.18$, $t(66) = 1.40$, $p = .17$, $\eta^2 = .03$. Again, as an indirect effect may exist in the absence of a significant direct effect (Shrout & Bolger, 2002), we tested whether ladders stimulate intragroup social comparisons, thereby reducing relationship quality and performance. A serial mediation analysis using bias-corrected bootstrapping with 5,000 resamples revealed that the effect of the ladder condition on group performance operated first through social comparisons and then via lower relationship quality (95% CI = [-1.30, -0.02]; Figure 2). Serial mediation analysis using intragroup trust (95% CI = [-0.92, -0.02]) or hierarchical conflict (95% CI = [-1.06, -0.01]) individually (rather than the composite) revealed similar results.

Discussion

Study 4 provides experimental evidence for the *causal* role that ladders and pyramids play in shaping group processes and outcomes. Whereas Study 3 provided cross-sectional

evidence from intact teams in the field that ladders have detrimental effects on relationship quality and performance in real-world teams, Study 4 showed that ladder-shaped (as opposed to pyramid-shaped) hierarchies causally increase social comparisons, thereby harming relationship quality within the group and ultimately the group's task performance.

Study 5: Addressing Alternative Explanations: Hierarchy's Perceived Stability and Mutability

Previous research on lay perceptions of hierarchy pointed to hierarchies' stability and mutability as important dimensions that shape how individuals experience them (Hays & Bendersky, 2015; Sligte, de Dreu, & Nijstad, 2011). In Study 5, we sought to replicate key elements of Study 4 while ruling out the alternative explanation that the effects of ladders and pyramids on group processes are due to differences in hierarchical instability and mutability.

Table 10. Descriptive Statistics of Study 5.

Variables	M	SD	1	2	3	4	5	6
1. Ladder condition (1 = yes, 0 = no)	0.54	0.50	—					
2. Intragroup social comparison propensity	5.76	0.79	.18**	—				
3. Intragroup trust	4.49	1.19	-.14*	-.17**	—			
4. Social support from the group	4.31	1.03	-.13*	-.17**	.75**	—		
5. Relatedness need satisfaction	4.28	0.91	-.12 [†]	-.21**	.63**	.74**	—	
6. Intragroup hierarchical conflict	5.25	1.03	.14*	.52**	-.33**	-.29**	-.27**	—
7. Relationship quality composite	-0.03	0.80	-.17*	-.34**	.86**	.88**	.84**	-.59**

Note. $N = 230$.

[†] $p < .10$. * $p < .05$. ** $p < .01$, two-tailed tests.

Method

Participants. Participants were 296 undergraduate students enrolled in an introductory management class at an East Coast university (50.5% female; age: $M = 19.99$ years, $SD = 1.08$; 23.7% White, 5.8% African American, 32% Asian, 12.7% Hispanic, and 25.8% Others), who took part in a 2-hr research session in exchange for course credits.

Design and procedure. We applied the same cover story as Study 4. Participants were asked to imagine that they and several other students were founding members of a start-up team and were told their task is to figure out which investors they should target for their upcoming seeding round. Participants were randomly assigned to the ladder hierarchy condition or the pyramid hierarchy condition. In the ladder (pyramid) condition, participants were informed that their group's hierarchy takes the form of a ladder (pyramid) and read the same information on group hierarchical levels as in Study 4. Participants then indicated how they would feel working on the task with other members of their group.

Measures

We measured all key processes and outcomes as in the prior studies, except group performance, which was not applicable in this setting. Specifically, participants indicated their propensity to engage in intragroup social comparisons ($\alpha = .87$) and rated their expected group's relationship quality along several metrics, including intragroup trust ($\alpha = .91$), perceived social support ($\alpha = .88$), relatedness need satisfaction ($\alpha = .83$), and hierarchical conflict ($\alpha = .87$), all on scales of 1 = *strongly disagree* to 7 = *strongly agree*, using the same measures described in Studies 2 to 4. An exploratory factor analysis with promax rotation showed that the four indicators of social relationship quality (social support, intragroup trust, relatedness needs satisfaction, and reverse-coded hierarchical conflict) were highly intercorrelated and loaded on a single factor (eigenvalue = 2.59, 64.72% variance explained).

We developed a composite measure by averaging standardized scores of these indicators ($\alpha = .79$).

Participants also indicated the extent to which they perceived their hierarchy (i.e., the ladder or pyramid, depending on their randomly assigned condition) to be "mutable" and "unstable" on scales ranging from 1 = *not at all* to 7 = *very much*.⁵

Participants completed multiple unrelated studies during the session. Hence, we applied multiple instructional and attention check questions to ensure participants' continuous attention. Participants had to recall correctly whether their team hierarchy represented the form of "ladder," "pyramid," "circle," "square," or other and the number of layers of their team hierarchy. In addition, following the recommendation by Mason and Suri (2012), participants were asked to select a specific answer of a set of two statements to gauge their attentiveness. Sixty-six participants failed these checks and were thus excluded from our analyses. Results are essentially similar without these exclusions.

Results

Table 10 depicts the means, standard deviations, and correlations among Study 5's variables.

Intragroup social comparison propensity. As predicted, participants assigned to the ladder condition reported significantly higher social comparisons propensity ($M = 5.89$, $SD = 0.74$) than those in the pyramid condition ($M = 5.61$, $SD = 0.82$, $t = 2.75$, $p = .01$, $d = 0.36$).

Relationship quality. As predicted, participants assigned to the ladder condition reported significantly worse expected relationship quality, including lower levels of intragroup trust ($M = 4.33$, $SD = 1.25$), social support ($M = 4.19$, $SD = 0.99$), and relatedness needs satisfaction ($M = 4.18$, $SD = 0.94$), and higher levels of expected hierarchical conflict ($M = 5.38$, $SD = 0.94$) and overall worse relationship quality (composite score: $M = -0.16$, $SD = 0.80$) than those in the pyramid condition (trust: $M = 4.67$, $SD = 1.10$, $t = 2.14$, $p = .03$, $d =$

0.28; social support: $M = 4.46$, $SD = 1.06$, $t = 2.05$, $p = .04$, $d = 0.27$; relatedness needs: $M = 4.41$, $SD = 0.88$, $t = 1.90$, $p = .06$, $d = 0.25$; hierarchical conflict: $M = 5.10$, $SD = 1.12$, $t = 2.07$, $p = .04$, $d = 0.27$; composite score: $M = 0.11$, $SD = 0.78$, $t = 2.58$, $p = .01$, $d = 0.34$).

Furthermore, we found that hierarchy shape had significant indirect effects on the relational outcomes via the propensity to engage in social comparisons. The 95% CIs for our dependent measures were as follows: trust: $[-0.17, -0.01]$, social support: $[-0.15, -0.01]$, relatedness needs satisfaction: $[-0.15, -0.01]$, hierarchical conflict: $[0.05, 0.35]$, and composite score: $[-0.19, -0.03]$. These findings replicate our previous findings concerning the mechanism underlying the effects of hierarchy shape on the quality of relationships within teams.

Participants in the ladder condition did not perceive their team hierarchy as more mutable ($M = 3.53$, $SD = 1.30$) or unstable ($M = 2.71$, $SD = 1.45$) than those in the pyramid condition (mutable: $M = 3.51$, $SD = 1.23$, $t = 0.14$, $p = .89$, $d = 0.02$; unstable: $M = 2.45$, $SD = 1.33$, $t = 1.39$, $p = .17$, $d = 0.18$). Furthermore, including perceived mutability and instability as control variables did not meaningfully change the aforementioned effects of hierarchy shape on relational outcomes (supplemental material T8a-8c).

Discussion

Consistent with Study 4's findings, Study 5 demonstrated a causal effect, whereby a ladder enhances group members' propensity to engage in intragroup social comparisons, thereby undermining the relationship quality within the group. Furthermore, Study 5's findings suggest that our observed effects are not driven by perceived differences between ladders and pyramids in mutability or instability.

General Discussion

Responding to a recent call to develop novel explanations of why hierarchy undermines social relations within groups and thereby group performance (Greer et al., 2018), we focused, in this article, on the important role of mental representations of hierarchy shapes. Specifically, we focused on the effects of two prominent hierarchy shapes that people commonly use to mentally represent and make sense of hierarchy: ladders and pyramids. Our findings consistently show that, relative to pyramids, hierarchies that individuals perceive to be shaped like ladders stir social comparisons within groups, thereby undermining relationship quality and group performance. These findings refine existing models of hierarchy, enhance our understanding of when and why hierarchy hurts group processes and outcomes (Greer et al., 2018; Halevy et al., 2011; Hays & Bendersky, 2015), and point to the importance of individuals' mental representations of their task groups in understanding the effects of group structures on group processes and outcomes.

Theoretical Contributions

The current article joins recent attempts to understand how different hierarchical shapes affect group processes and outcomes (Bunderson & Van der Vegt, 2018; Greer et al., 2018). Prior research has focused on the degree of hierarchical differentiation within groups (Ronay, Greenaway, Anicich, & Galinsky, 2012), or the effects of different distributions of hierarchy on group outcomes (centralization vs. acyclicity; Bunderson et al., 2016). Although these works have provided important insights into the effects of hierarchy, they overlooked group members' mental representations of the shape of their group's hierarchy.

The current findings demonstrate that the way in which individuals mentally represent the form of their group's hierarchy, as a ladder or a pyramid (which is related to the actual form hierarchy takes), is a key determinant of when hierarchy detracts from group dynamics and outcomes. In addition, we have identified *why* ladders detract from group processes and outcomes. Compared with pyramids, the rank differentiation in ladders highlight rank differences between members within the group, thereby promoting intragroup social comparison propensity, and degrading intragroup relationship quality and group performance. With these findings, we provide a new (visual) lens through which the effects of hierarchical shapes may be examined and interpreted.

The current findings also suggest that the functions and dysfunctions of hierarchy (Greer et al., 2018; Halevy et al., 2011) may depend on hierarchy's actual and perceived shape. Our findings suggest that pyramid-like hierarchies can support within-group processes and group performance (Study 3) or at least not harm it (e.g., Study 2). In contrast, in line with conflict theories, our findings consistently show that ladder-like hierarchies are detrimental to groups: They undermine group members' relationships and hinder their collective performance.

Finally, the current research builds a bridge between the literature on social and organizational hierarchies (Greer et al., 2018; Halevy et al., 2011; Magee & Galinsky, 2008) and the literature on social motives and social relations (Baumeister & Leary, 1995; Ryan & Deci, 2000b). The current work suggests that paying attention to the manner in which individuals perceive and experience their social environment, and the ensuing social processes, can help researchers understand why and how hierarchy influences group processes and outcomes.

Strengths, Limitations, and Future Directions

In the current research, we employed different methodologies to compare ladders' and pyramids' consequences for group processes and outcomes in lab settings as well as in the field. The converging evidence found across these studies strengthens our confidence in the robustness of the observed effects. Of course, our research is not without limitations, which provide fodder for future research.

First, although we found that ladders negatively influence group processes and outcomes, it is possible that certain features of individuals and groups may lessen or even reverse the harmful effects of ladders. Although we began exploring these possibilities in Study 5, by considering the role of hierarchical stability and mutability, future research is required to address the boundary conditions of our observed effects. Researchers may explore the important role that structural mutability can play in shaping social relationships (independently of hierarchy's shape). For example, mutability may particularly decrease relationship quality in pyramids by making peer competition salient. Relatedly, the negative effects of ladders may be attenuated depending on where one is in the hierarchy, with those at the very top or bottom ranks experiencing the most intense negative effects of hierarchical shapes (Garcia & Tor, 2007). Furthermore, the effects of ladders on the quality of social relations within groups may be particularly harmful in contexts in which there is little interdependence among group members (Bloom, 1999; Ronay et al., 2012). Future research may also explore the possibility that an organizational culture that emphasizes the quality of relationships within teams may sacrifice team performance as a result. Indeed, previous research found a negative association between a supportive organizational culture and sales growth (Berson, Oreg, & Dvir, 2008). Thus, the competitive internal dynamics produced by ladders may not always undermine team performance. Future research may explore these possibilities.

Second, we propose and find that individuals base their mental representations of hierarchical shapes on the actual distributions of influence within groups. That is, individuals tend to mentally represent stratified hierarchical structures as ladders and centralized hierarchical structures as pyramids (Study 1). We also found consistent results while these geometric shapes are manifested from mental representation (Study 2), actual distribution (Studies 3 and 4), or both (Study 5). However, the finding that reality constrains mental representations of hierarchical shapes does not preclude the possibility that people vary in their propensity to view hierarchies as ladders versus pyramids, or perceive variations within ladders or pyramids. Future research may explore the consequences of shared versus unshared mental representations of hierarchy shapes (i.e., what happens when different group members mentally represent the hierarchy similarly vs. differently) on group processes and performance.

Third, future research may consider other shapes that individuals may use to mentally represent hierarchy, as well as their associated outcomes. Recent work suggests that hierarchy can be viewed as dyadic influence ties (i.e., acyclicity; Bunderson et al., 2016). Future research may consider how individuals mentally represent acyclicity, as well as the downstream consequences of these mental representations. Relatedly, researchers may examine whether the effects of hierarchy's shape vary as a function of specific hierarchical

dimensions (e.g., power, status, formal rank; Magee & Galinsky, 2008), and explore how misalignment between different bases of hierarchy (e.g., hierarchies in which power and status correlate only weakly) influences the way people mentally represent group hierarchy.

Fourth, in the current research, we focused on social comparisons and relationship quality as the primary mechanism carrying the effects of hierarchy shape to group performance. Future research may consider other potential mechanisms. For example, researchers may explore how ladders versus pyramids affect group members' perceptions of fairness (Blader & Tyler, 2003), as well as whether fairness perceptions carry the effects of hierarchy shape to team performance. Researchers may also examine the role that particular dyadic interactions play in determining the effects of ladders versus pyramids. For example, researchers may explore how dyadic leader–follower exchanges between individuals at the top and at the bottom of ladders versus pyramids shape group members' experiences and group outcomes.

Finally, future research may explore the extent to which the current findings generalize across different contexts. The meaning and impact of the same kind of hierarchical shape (i.e., ladder or pyramid) may change in interdependent as compared with independent culture (Markus & Kitayama, 2010). For example, in interdependent culture where harmonious relationships are emphasized, the negative effects of ladders on relationship quality might be reduced. Given that the quality of relationships carries the effect of hierarchical shape to group outcomes, one specific direction for future research is to compare the consequences of hierarchical ladders and pyramids in contexts that vary in their emphasis on harmony and interdependence within groups.

Practical Implications

Our findings have important practical implications. The finding that ladders harmed group relationships and thereby impeded group performance should encourage practitioners (e.g., coaches, consultants, managers) to pay close attention to group dynamics in groups whose members tend to experience their hierarchies as ladders (such as those references in the opening quotes to this article). Our findings should not be taken to necessarily mean that ladders must be avoided in all contexts. Rather, we encourage practitioners to consciously weigh the extent to which the benefits that come from a stratified incentive structure outweigh the potential costs that accrue when group members perceive their hierarchy as a ladder. Where and when applicable, practitioners should think of possible ways to counter and compensate for the relational costs of ladders. Previous research suggests that interventions such as group uniforms can help build a shared identity for group members (Van Bunderen et al., 2018). Means of instilling group members with a sense of shared purpose may help attenuate or circumvent the challenges that groups with ladder-represented hierarchies face.

Conclusion

The current research shows that individuals' mental representations of different hierarchical shapes have distinct consequences for group processes and outcomes. We found that ladders are more likely than pyramids to harm social relations within groups and thereby group performance. By identifying the adverse effects of ladder-shaped (relative to those of pyramid-shaped) hierarchies on intragroup social relationships, the current work elucidates the conditions under which conflict perspectives (Greer et al., 2017) outperform functionalist approaches (Halevy et al., 2011) in explaining hierarchy's consequences. Particularly, we suggest that the observed detrimental effects of hierarchy may be explained by group members' tendencies to mentally represent their group hierarchy as a ladder. These findings highlight the importance of understanding how group structures are visually represented by their group members and paves the way for new research possibilities concerning the virtues and vices of social and organizational hierarchies.

Acknowledgments

We are thankful for the exceptional editorial guidance of Michael Robinson and constructive comments from the three anonymous reviewers. We also wish to thank Gavin Kilduff and Christopher To for their valuable feedback on earlier versions of this paper. We would like to acknowledge the exceptional support of the Behavioral Lab at the Stanford Graduate School of Business for their help with data collection.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Notes

1. A separate line of research examines hierarchy as dyadic information flow, or acyclicity (Krackhardt, 1994). In this article, we build on the inequality approach and focus on the effect of different hierarchy shapes on group processes and performance.
2. Sample inclusion criteria were (a) groups' response rate was higher than 50% and (b) group size ranges between three and 15 people (Wilson & Hanna, 1990; approximately 75% and 80% of the two organizations of the full samples that provided sufficient response).
3. Twenty-three teams' performance was missing due to nonresponse of the manager.
4. For exploratory purposes, we also included an egalitarian condition. Because results of this condition ($N = 37$ groups) are beyond the scope of the current article, we report them in the supplemental material.
5. See the supplemental material for additional items employed for exploratory purposes.

Supplemental Material

Supplemental material is available online with this article.

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