While hierarchy in teams has gained particular prominence in the field of social science, including I-O and social psychology (see Greer, de Jong, Schouten, & Dannals, 2018, for a recent review), empirical evidence of how hierarchy impacts team effectiveness has been mixed (Anderson & Brown, 2011, Halevy, Chou, & Galinsky, 2011). For example, researchers have found that while hierarchy is associated with lower team performance in baseball (Bloom, 1999), it also results in better team performance in basketball (Halevy, Chou, Galinsky, & Murnighan, 2012). Thus, the purpose of this study is to investigate the systematic differences in the effect of hierarchy on team effectiveness.

Hierarchy and Team Effectiveness

It has been argued that hierarchy's impact on team effectiveness depends in part on the task types or task demands of the team (cf. Anderson & Brown, 2010; Halevy, et al., 2011). Recent studies reveal that teams can be successful on problem solving tasks that demand aggregation of members' knowledge and ideas when contributions among group members are equal (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010). Thus, for such tasks, hierarchy is harmful to team performance, as it inhibits equal contributions among members (cf. Anicich, Swaab, & Galinsky, 2015). In contrast, some studies suggest that hierarchy facilitates team effectiveness for tasks in which members' actions are highly interdependent and thereby coordination is essential (Halevy et al., 2012; Kwaadsteniet & van Dijk, 2010).

Despite such accumulation of studies, there are still challenges to be addressed in terms of small teams in industrial organizations. Few studies have been conducted on small teams within industrial organizations. Past studies on

hierarchy have focused on small teams in sports (Anicich et al., 2015; Bloom, 1999; Halvey et al., 2012) or on firm-level effects in the I-O context (Wade, O'Reilly, & Pollock, 2006). However, since small teams are essential units in industrial organizations, where people work together and practical decisions and actions take place, the impact of hierarchy on team effectiveness should be examined more closely. Further, there is little direct empirical evidence showing that in industrial organizations task demands moderate the effect of hierarchy on team effectiveness. For example, the arguments of task interdependence (Halevy et al., 2011) are based on a comparison between baseball and basketball. Although their arguments are persuasive, there still may be other factors that affect the observed differences, such as players' typical characteristics and cultural differences between the sports.

Organizational Teams and Task Demands

In this study, we investigate the interactive effects of hierarchy and task demands on team effectiveness with focusing on small teams in an organization. A comparison within an organization makes it possible for researchers to exclude other potential explanatory factors, such as typical characteristics and cultural differences. Since data from within-company is necessary to accomplish this, we use an HR dataset from one company (details are described in the Method section). Also, task demands can be effectively captured in industrial organizations. In our analysis, by considering the smallest units in an organizational chart as "teams," we treat the goals or purposes assigned to the teams as the task demands of each team. Accordingly, we distinguish two prototypical task demands in a firm (cf. De Dreu & Weingart, 2003; Hollenbeck et al., 2012); one type is "problem solving" or "planning" (hereafter P-type demands), and the other type is "task execution" or "operations"

(hereafter O-type demands). In the taxonomy of De Dreu and Weingart (2003), the former are referred to as "project teams" and the latter are "production teams." They argued that project teams deal with tasks, including planning and decision making, that were the "most uncertain, most complex, or least routine," whereas a production team deals with tasks, including task execution, that were "less uncertain, less complex, or more routine" (De Dreu & Weingart, 2003: 744).

Interactive Effect of Hierarchy and Task Demands

We assumed that while teams engaged mainly in P-type demands will be successful through effective aggregation of ideas and knowledge (cf. Koriat, 2012; Page, 2007), teams engaged in O-type demands will be more productive through efficient coordination (Halevy et al., 2012). Specifically, we predict that hierarchy has a negative effect on team effectiveness in teams with P-type demands since it requires effective aggregation which can be achieved through equal contribution (e.g., Woolley et al., 2010) because hierarchy is, by definition, a vertical differentiation among members (cf. Greer et al., 2018; Magee & Galisnky, 2008), which is the opposite of equality. Although logic leads to a prediction of a positive effect in teams with O-type demands, as past studies have found in coordinating teams (e.g., Halevy et al., 2012), we have some reservation about this because coordination in firms can also be induced through designed task division. In such cases, the positive effect of hierarchy may be less prominent. In sum, we hypothesize the following:

Hypothesis 1. Hierarchy negatively affects team effectiveness only in teams with P-type demands, not in teams with O-type demands.

Accordingly, we also predict that the negative effect of hierarchy on team effectiveness will be mediated by decreased equality in contribution among members. Thus, we hypothesize the following:

> **Hypothesis 2a.** For teams with P-type demands, equality in contribution will mediate the effect of hierarchy on team effectiveness by relating positively to team effectiveness and negatively to the level of hierarchy.

In addition, as described above, coordination among team members will be more important for teams with O-type rather than P-type demand. A factor that enhances coordination is common knowledge of who does what and who knows what (cf. (Liang, Moreland, & Argote, 1995; Wegner, 1986). Thus, we predict that clear perception in role sharing or task division among team members should improve coordination, and consequently team effectiveness, for teams with O-type demands. However, in the I-O context, teams will have an explicit consensus about role sharing regardless of hierarchy. Therefore, we have a reserved prediction about this relationship and, consequently, the mediation effect of clarity. In sum, we hypothesize the following:

> **Hypothesis 2b.** For teams with O-type demands, clarity in role division will positively relate to team effectiveness, but not to the level of hierarchy.

To examine these hypotheses, we conducted an HR data analysis by combining personnel data from the HR department, organizational survey data they had conducted for management purposes, and insiders' knowledge of the task demands of each team in the company.

Method

Sample

Our sample was drawn from a headquarter office of a large Japanese conglomerate. From a personnel management purpose, the headquarter staff belongs to a functional subsidiary in the company group, which is our target firm.

Part of the data collection was conducted as a company-wide employee survey for organizational diagnosis, which involved the entire population of the target firm. There were 228 respondents out of a possible 241, a response rate of 94.6%. We also obtained personnel data including affiliation information and "role grade," or employee rank. The target company adopted a role grade system, in which all employees are assigned to a "role grade" based on both their ability and job-rank. The grades are determined and modified every half-year and are connected to employees' base salaries.

For our analysis, we treated the smallest units in the organizational chart as the unit of analysis, which we called "teams." To test our hypotheses, we utilized teams that had three or more members from all respondent teams. This screening procedure resulted in a final sample of 25 teams; the average team size was 5.8 and median was 5. Typically, these teams have one manager. Because of the company's management policy, there are no other titles or positions in teams; therefore, we do not need to consider confounding differentiations such as status and prestige.

Measures

This study has two main explanatory variables: hierarchy and task demands. We operationally defined hierarchy as the standard deviation (SD) of role grades in each team. While there might be several ways to measure hierarchy (cf. Greer et al.,

2018), following previous studies (e.g., Halevy et al., 2012), we used the SD as the index. We focus on the SD of role grades because it represents members' capabilities in their roles, which are vertically differentiated in teams (Greer et al., 2018), and because they are directly related to salaries, which have been used to measure hierarchy in previous studies (e.g., Bloom, 1999; Halevy et al., 2012; Wade et al., 2008).

For task demands, we had several firm insiders code each team's type of task demand. They were asked to evaluate whether the types of tasks faced by each team were O-type (task execution or operation) or P-type (problem solving or planning). This evaluation seemed simple for the insiders, so the distinctions were agreed upon without any conflicts. As a result, we have 18 teams with O-type task demands (hereafter "O-type teams") and 7 teams with P-type task demands (hereafter "P-type teams"). An example of O-type teams is the accounting team that closes the books for the business units each month, and an example of P-type teams is the finance team that plans and executes the group financial strategy.

Outcome variables and mediation variables were constructed from the organizational diagnostic survey. The survey items were generally about respondents' perception of their team (e.g., "Our team can make use of expertise and provide the customer's expected value"), their own ability (e.g., "I understand the characteristics and needs of customers in detail"), and relationships with the company's management board (e.g., "The management board always requests us to work together across departments"). Respondents indicated the level of their agreement to each item on a 5-point scale, with options ranging from 1 (do not agree at all) to 5 (very much agree). Note that the survey was not designed for research

purposes but for company management purposes. Therefore, although the survey included a wide variety of items, there were no established psychological scales. To create our own measurement of team effectiveness from the organizational diagnostic survey items, we conducted factor analysis and found three factors, one of which can be interpreted as team effectiveness (details are described in the Result section).

For mediation variables, we used two items out of five that did not load onto any of the three factors. We operationalized "clarity in role division" as the rating of "In my team, it is clear who to ask (tell) when there is something I want to know (tell) at work," and "equality in contribution" as that of "My current workload is appropriate, neither too much nor too little." Note that the team average of these items indicated the degree of collective perception on transparency and non-biasedness of task sharing among members. Because no items fell into the same factor as these items, they were treated as single-item scales.

Results

Factor analysis

We conducted an exploratory factor analysis on the scores of the 45 item in the organizational diagnostic survey using the maximum likelihood method and promax rotation. The unit of analysis was the individual. The scree plot suggested a three-dimensional structure with the first three factors having eigenvalues of 14.3, 4.4, and 2.6, explaining a total of 47.2% of the variance. The first factor consisted of 23 items (Table 1), which were mainly about team performance and team viability, the two key aspects of team effectiveness (Greer et al., 2018; Kozlowski & Ilgen, 2006). For example, the aspect of team performance (Bell, 2007; Devine & Philips,

2001) was represented by items in the survey such as "Our team can make use of expertise and provide the customer's expected value" and "Our team can catch up on environmental changes surrounding customers, and reflect them in the team's policy and decision-making." Also, the aspect of team viability (Balkundi & Harrison, 2006) was represented by such items as "My team is a workplace where I want to continue working" and "I can trust my boss and colleagues in working together in my team." We created a composite measure of team effectiveness by averaging the responses of the 23 items, and used the team average of that as the outcome variable in the following team-level analyses. Although these 23 items included respondents' perception not only on teams but also on bosses and themselves, the team average of such items was considered as the degree of team-level effectiveness.

As mentioned above, the factor analysis showed other two factors related to evaluation of their own ability and the company's management board, which we do not report here.

Effects of hierarchy and task demands on team effectiveness

Since the unit of analysis is a team in the following analyses, we generated a team-level score of team effectiveness by averaging the scores of members in each team (ICC = .290). Simple plots of team effectiveness for each team by hierarchy and task demands are shown in Figure 1. To examine the hypothesized interaction effect, we conducted a regression analysis of team effectiveness. The model included the team's SD of role grades (centered), task demand (0 = O-type, 1 = P-type), and their interaction, with the team mean of role grades and team size as covariates (both centered; Table 2). As predicted in Hypothesis 1, the team SD of role grades

and task demands showed significant interaction (β = -.45, $p < .01$). A simple slope analysis found that, as seen in Figure 1, the team SD of role grades was negatively associated with team effectiveness only for P-type teams (β = -.52, $p < .001$) and not for O-type teams (β = -.07, *ns*).

To test Hypothesis 2a, we conducted mediation analysis for P-type teams. Although model fit was not satisfactory (CFI = .98, TLI = .90, RMSEA = .32) presumably due to the small sample size ($n = 7$ for P-type), the hypothesis was confirmed (Figure 2a). As predicted, the team SD of role grades was negatively associated with equality in contribution (b = -0.49, SE = 0.14, $p < .001$), and positively associated with team effectiveness (b = 0.68, SE = 0.23, $p = .003$). The indirect effect of team SD of role grades on team effectiveness through contribution equality was significant (b = -0.34, SE = 0.13, $p = .012$, adjusted bootstrap percentile interval = -0.98 to -0.17). On the other hand, clarity in role division was not associated with team SD of role grades (b = -0.35, SE = 0.28, $p = .207$), or with team effectiveness (b = -0.06, SE = 0.21, $p = .767$).

A mediation analysis for O-type teams yielded results supporting Hypothesis 2b, although model fit was not satisfactory (CFI = .98, TLI = .90, RMSEA = .32). Note that sample size for O-type teams was also small ($n = 18$ for O-type). As predicted (Figure 2b), clarity in role division had a positive relationship with team effectiveness (b = 0.26, SE = 0.13, $p = .047$). However, as we expected, clarity in role division was not related to SD of role grades (b = -0.05, SE = 0.15, $p = .717$). The SD of role grades was positively associated with contribution equality (b = 0.22, SE = 0.08, $p = .003$), while contribution equality was not associated with team effectiveness (b = 0.08, SE = 0.21, $p = .703$) for O-type teams.

Discussion

The results of this study indicated that hierarchy had a negative effect in teams facing P-type demands (problem-solving or planning) but not in teams facing O-type demands (task processing or operations). Further, such differences were mediated by different team processes, such as equal contributions and role clarity.

In terms of contributions to the hierarchy research literature, we empirically showed that task demands in organizational teams differentiated how hierarchy impacted team effectiveness within a firm. Task demands or organizational purposes are essential for organizational teams embedded in a larger structure, because they are connected to the higher-level purpose (as seen in mission trees or mission structures in an organization). As such, task demands will shape behaviors and interaction patterns of managers and team members in their daily practices, which resulting in the differentiation in the effect of hierarchy and important group processes.

From the practical perspective, this study suggests that managers in organizations should design their teams in accordance with types of task demands. Managers for teams with P-type demands should select members to create teams that are less differentiated in terms of knowledge, skill, and experiences. In addition, they should activate team-participation for all members and reallocate role divisions when workload is too concentrated on specific team members. In contrast, managers for teams with O-type demands do not need to pay much attention to the degree of vertical differentiation among members, but should ensure that all members have a clear understanding and common knowledge of the role division within the team.

One limitation of this study is that we only examined data from a single company, although we had a relatively high response rate from employees, as well as insider information. Generalizations to other types of organizations and industries should be made with caution. Future research is therefore needed to see if our results are consistent among organizations with different characteristics or in different industries.

Our results showed task demands moderate the effect of hierarchy on team effectiveness in I-O contexts, suggesting that managers need to consider both task demand and hierarchy in their teams to increase team effectiveness.

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Table 1
Items and factor loadings for team effectiveness (factor I)

	I
I can trust my boss and colleagues in working together in my team.	.88
Evaluation and feedback from my boss are clear and reasonable.	.87
My boss has reasonably set up my role with considering my characteristics (strengths, weakness, intentions, etc.)	.87
Our team is a workplace where I want to continue working.	.85
Our team has a climate that allows us to speak our thoughts and ideas frankly.	.74
Managers decide the scope, and then leave it to us, and request us to take the initiative from there.	.73
I have a clear understanding of what is expected of me in my work.	.73
I can fulfill my potential in my current work.	.71
In our team, we are working toward a common goal.	.67
In our team, people who deserve it are appreciated.	.67
There is a person in our team with whom I can consult in mentally and/or physically difficult times.	.66
My boss will give me good counsel and advice on my personal career.	.66
Our team will keep making use of expertise and providing the customer's expected value going forward.	.53
Our team can make use of expertise and provide the customer's expected value.	.49
Managers told us the background of the strategies and policies in their own words	.46
Our team has a climate to praise and acknowledge each other for good challenges and achievements.	.44
Our team has a climate to back up a person in need.	.43
Managers listen to members' voices based on customer needs.	.43
Our team has a climate to encourage and appreciate new challenges and initiatives for the future.	.43
Our team has a climate to exchange tough feedback and frank opinions at times for each other.	.41
My boss put values on efficient work in a shorter time without decreasing the quality of work.	.41
Our team can catch up on environmental changes around customers, and reflect them in the team's policy and decision-making.	.37
I have experienced challenging new things and tasks that I thought were difficult for me this year	.37

Note. This table shows 23 items and their factor loadings for team effectiveness (Factor I) only. The remaining 22 items in the diagnostic survey and factor loadings for the other two factors (II and III) are not reported.

Table 2
Regression analysis of team effectiveness

|	b	(SE)	β	p
Team SD of role grades (centered)	-0.07	(0.09)	-.16	.420
Task demands (0 = O-type, 1 = P-type)	-0.41	(0.17)	-.40	.028
Team M of role grades (centered)	0.03	(0.05)	.11	.590
Team size (centered)	0.00	(0.03)	-.02	.890
Team SD of role grades x Task demands	-0.45	(0.14)	-.61	.004
adjusted R^2	0.55			< .001

Figure 1.
Simple plots of each team type on team effectiveness
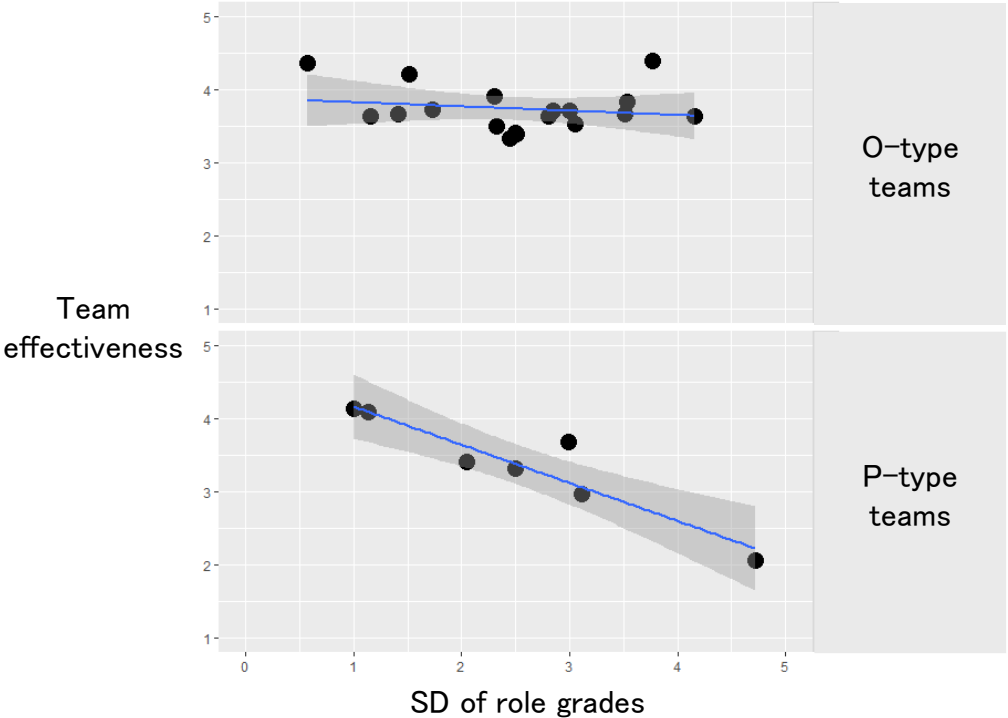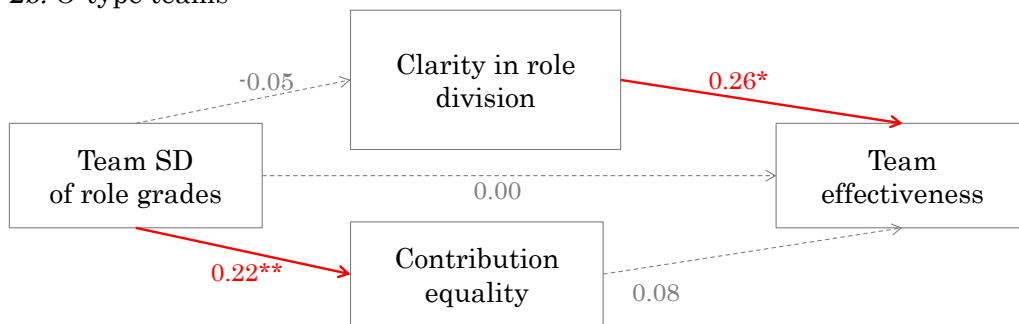
Note. Each dot represents a team.

Figure 2
Mediation analysis

2a. P-type teams
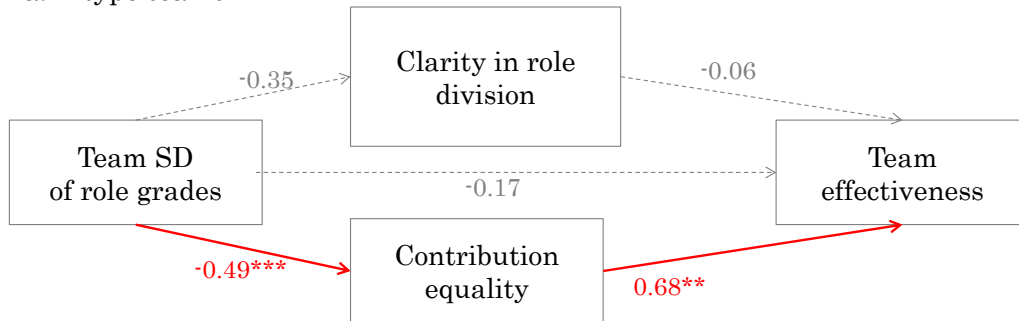
2b. O-type teams

Note. Unstandardized path coefficients are presented. Solid red arrows represent significant paths, while dashed gray arrows represent non-significant paths. Asterisks indicate the significance of the coefficients (*p < .05, **p < .01, ***p < .001)