Team Autonomy, Performance, and Member Job Strain: Uncovering the Teamwork KSA Link

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Given the increasing use of work teams in organizations, interest exists in identifying the best ways to design teams so that they lead to positive outcomes. This study examined how team autonomy and teamwork knowledge, skills, and abilities (KSAs) relate to team performance and member job strain. Based on extant empirical and theoretical work, two models were tested. Findings from a sample of 41 production teams (174 team members) showed support for the mediation model—that autonomy is associated with performance and strain through teamwork KSAs. The alternative moderation model, suggesting that autonomy and teamwork KSAs interact in predicting performance and strain, was not supported.

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INTRODUCTION

Teamwork is increasingly popular in contemporary organizations, with research suggesting that the use of autonomous work groups or self-managing teams in particular is becoming more prevalent. In the UK it was found that 40% of personnel managers reported that their organization had some form of self-managed teams (Industrial Society, 1995). Three years later, results from the Workplace Employee Relations Survey found in 65% of workplaces that “most employees were in formally designated teams” (Cully et al., 1998, p. 10). Similarly, a survey based on a representative sample of UK manufacturing companies conducted in 1996 found that 55% reported at least moderate use of self-managing teams (Waterson et al., 1999); with a follow-up study three years later showing this figure had risen to 66% (Wood, Stride, Wall, & Clegg, 2004). Looking more widely, Clegg et al. (2002), in an international comparative study (building on the survey of Waterson et al., 1999), found that use of self-managing teams was even greater in Australia and Switzerland than in the UK (though less prevalent in Japan).

That this is a more global trend is suggested by findings from the United States. Cohen, Ledford, and Spreitzer (1996), for example, reported that by 1990 almost half of the largest companies were using self-managed work teams in at least some areas of work activity. Correspondingly, Osterman (1994) found teams were used by 54% of leading organizations; and a longitudinal study of Fortune 1000 companies showed an increase in the use of teams from 27% in 1987 to 68% in 1993 (Lawler, Mohrman, & Ledford, 1995).

It may be that such surveys overestimate the true extent of teamworking, and that the teamworking revealed by the studies may not always be fully-fledged. However, the trend is clear. This gives credence to the view that there is a “current wave of interest in teamworking” (Mueller, Proctor, & Buchanan, 2000, p. 1388), and that “interest in team-based systems of work organization appears to have reached new heights” (Delbridge, Lowe, & Oliver, 2000, p. 1460). It also fuels interest in identifying the best ways to design teams so that they lead to positive organizational and employee outcomes. Of interest to this study is how one central design factor, team autonomy, relates to team performance and member job strain while considering teamwork knowledge, skills and abilities (KSAs).

Teamwork Design

Though teamwork is high on today’s agenda, interest in this form of work organization stretches back many decades, to the pioneering work of the Tavistock Institute in London (e.g. Rice, 1958; Trist & Bamforth, 1951;
Trist, Higgins, Murry, & Pollack, 1963) and beyond. A legacy of that early socio-technical systems approach has been to focus attention on the design of work teams. One such design characteristic is team autonomy, referring to the level of discretion or autonomy afforded to groups of interdependent employees. Members of teams with autonomy are typically responsible for the day-to-day management of “some natural unit of work” (Cordery, 1996, p. 225), involving decision making (e.g. task allocation and execution) and problem solving (e.g. fault rectification), as well as other general duties (e.g. training recruits).

Empirical studies of team autonomy have examined its relationship with a host of factors and outcomes. Two outcomes receiving considerable attention, due both to their theoretical and practical relevance, are team performance and member job strain. From a theoretical standpoint, team performance outcomes are assumed to accrue from the motivational benefits of enriched jobs, from the opportunity for team members to respond rapidly and flexibly to work demands (cf. the socio-technical principle of “control of variance at source”, see Cherns, 1976; Parker & Wall, 1998), and from gains in members’ skills and knowledge which greater involvement in work activities affords (e.g. Wagner, Leana, Locke, & Schweiger, 1997). Furthermore, organizations should benefit from indirect labor savings (i.e., a reduction in both technical and managerial support costs) as teams take on responsibility for day-to-day duties and tasks. The benefits with regard to job strain follow not only from the assumed greater need fulfillment and social support provided by autonomous teamwork (Herbst, 1974), but also because autonomy allows team members discretion over when and how to deal with job demands, thus decreasing strain (Karasek, 1979; Karasek & Theorell, 1990).

Although effective teamwork can be affected adversely by many factors (e.g. uncooperative behaviors, inadequate process skills, poor technical skills), evidence to date supports the above theoretical expectations, in that numerous studies have found that teams with greater autonomy have better performance and lower member strain (e.g. Cordery, Wright, & Wall, 1997; Herbst, 1974; Karasek & Theorell, 1990; Kasl, 1989; Manz & Sims, 1993; Wall & Clegg, 1981; Wall, Kemp, Jackson, & Clegg, 1986). Such evidence is consistent with inquiry at the individual level. For instance, change studies have found that enhanced autonomy for operators of complex technology is effective in improving output (e.g. Wall, Jackson, & Davids, 1992), and studies of the demand-control model have shown that decision latitude (autonomy) is negatively related to strain (e.g. Wall, Jackson, Mullarkey, & Parker, 1996). Though some studies have failed to show such confirmatory effects (e.g. Goodman, Devadas, & Griffith-Hughson, 1988), we are unaware of any adverse findings (i.e., an increase in autonomy leading to reduced performance or greater strain).

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Despite the marked appeal of teamwork design generally, and autonomy more particularly, it is unlikely to be the sole determinant of, or provide a complete explanation for, individual- and team-level outcomes. For this reason studies have examined the effects of individual factors (e.g. cognitive ability, personality) on team effectiveness (e.g. Barrick, Stewart, Neubert, & Mount, 1998; Barry & Stewart, 1997; Neuman & Wright, 1999). Furthermore, studies of team training have emphasized the importance of skill-based factors as determinants of effectiveness (e.g. Tannenbaum, Beard, & Salas, 1992; Tannenbaum, Salas, & Cannon-Bowers, 1996). An underlying deficiency, however, is one of integration, that is, studies to date have rarely examined team characteristics and team skills at the same time.

A partial exception to this differentiation in research is the work undertaken by Campion and colleagues (Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996) who found that performance was more strongly associated with team-process variables, such as workload sharing and communication, than with team characteristics, such as task variety and degree of self-management (autonomy). This notwithstanding, and reflecting research more generally, they did not examine the likely interplay between team characteristics and team-process variables.

These deficiencies are problematic because they narrow the field of inquiry and limit analysis to direct relationships between team characteristics (e.g. managerial support, autonomy) and outcome criteria (e.g. performance, strain). More specifically, such deficiencies preclude comprehensive theoretical development and restrict practical recommendations concerning team design. This study seeks to address some of the research deficiencies by examining how team autonomy together with teamwork KSAs relate to team performance and member job strain.

**Teamwork KSAs**

From an extensive review and analysis of the team literature, Stevens and Campion (1994) identified 14 team member knowledge, skill, and ability requirements (i.e., requisite process skills) for teamwork, such as: recognize and encourage desirable, but discourage undesirable, team conflict; listen nonevaluatively and use active listening techniques (aspects of effective communication); coordinate tasks and assign appropriate members to specific duties; and help establish specific, challenging, and accepted team goals. To assess the KSAs, Stevens and Campion developed a situational test hereafter referred to as the teamwork-KSA test.

Research on the teamwork-KSA test is generally supportive of its efficacy in understanding individual and team behavior. Stevens and Campion (1999) provided two validation studies examining the teamwork-KSA test. The first investigated incumbent employees of a pulp processing mill.
(n = 70) who were applying for jobs within a newly constructed mill. The teamwork-KSA test correlated both with supervisory ratings of employee teamwork performance (comprising measures of communication, team contribution and self-management; $r = .44$, $p < .01$) and ratings of overall job performance (comprising measures of teamwork performance together with learning orientation and technical knowledge; $r = .52$, $p < .01$). To calculate such ratings, scores obtained from multiple independent supervisors were averaged. Stevens and Campion’s second study involved employees from a cardboard processing company (n = 72), for whom the teamwork-KSA test was found to correlate both with supervisory ratings of teamwork performance ($r = .21$, $p < .05$) and rankings by peers ($r = .23$, $p < .05$). They reasoned that the weaker correlations of this study, relative to the first, reflected the fact that participants were volunteers rather than participants applying for jobs.

In addition, McClough and Rogelberg (2003) found that the teamwork-KSA test successfully predicted individual team member behavior as indexed by external raters ($r = .31$, $p < .01$) and peers ($r = .34$, $p < .01$), such that higher scores on the teamwork-KSA test related to greater individual effectiveness within teams.

**Why Study Teamwork KSAs?**

In this study we chose to study teamwork KSAs along with autonomy, team performance and member job strain for a number of reasons. With respect to performance, the relevance of KSAs is manifest, since the very concept of skill implies greater effectiveness. More specifically, higher performance is assumed to stem from members’ capacity to set appropriate goals, resolve conflicts and in other ways contribute to the management and coordination of the work in an effective and timely way (Stevens & Campion, 1994, 1999). This is consistent with Medsker and Campion’s (1998) assertion that team effectiveness “can depend heavily on members’ interpersonal competence or their ability to maintain healthy working relationships and to react to others with respect for their viewpoints” (p. 475). The aforementioned validation work (e.g. Stevens & Campion, 1999) certainly supports this supposition.

With regard to strain, the premise is that teamwork KSAs will mitigate the effects of work demands by increasing employees’ ability to cope with them, for example because those skills serve to minimize interpersonal conflict, and by affecting strain-related perceptions. This line of argument is inherent in several leading models of strain, most notably in the “Dynamic Demand-Control Model” proposed by Karasek and Theorell (1990), which holds that “feelings of mastery inhibit strain perception” (p. 99).

More importantly, though, we chose to study teamwork KSAs because we believe its relationship with autonomy in understanding team performance and member job strain is potentially important from both a theoretical and
practical perspective. Interestingly, past empirical and theoretical work suggest two main models for understanding how autonomy and teamwork KSAs may work together to explain team performance and member job strain. The rationale underlying both models is considered below.

The Mediation Model

The mediation model posits that KSAs mediate the relationship between autonomy and performance and between autonomy and job strain. The rationale for the effect of KSAs on performance and strain is as discussed above (i.e., the concept of skill implies greater performance, and KSAs will mitigate the effects of work demands by increasing employees’ ability to cope with them). The distinctive feature of this model concerns the effect of autonomy on KSAs.

There is considerable theoretical justification for assuming that autonomy will be related to KSAs. For example, Action Theory (Hacker, 1986; Hacker, Skell, & Straub, 1968) casts autonomy as a prerequisite for learning or skill development. Frese and Zapf (1994) describe the theory’s implications thus: “skills can only be acquired . . . when there is control at work” (p. 319). Herzberg (1966) made a parallel observation on the basis of his two-factor theory, and the form of job design (i.e., job enrichment, characterized by increased autonomy) to which that theory gave rise. He argued that: “job design promotes psychological growth which involves knowing more, seeing more relationships in what we know” (p. 76). Lawler (1992), promoting the idea of “high involvement organizations”, similarly argued in their favor by reasoning that: “because they have the autonomy to make ongoing improvements, employees can also fine-tune and make adjustments in the work process as they become increasingly more knowledgeable about how the work can best be done” (p. 85).

Empirical work has further demonstrated how initiatives increasing employee autonomy not only encourage employees to use their existing knowledge better but also to learn new skills (Jackson & Wall, 1991; Wall, Corbett, Martin, Clegg, & Jackson, 1990; Wall et al., 1992). There is a parallel here with a study reported by Campion, Cheraskin, and Stevens (1994), who found that work experience through job rotation was associated with the acquisition of interpersonal and communication skills.

The Moderation Model

The moderation model contends that autonomy and KSAs interact to predict performance and strain. With regard to performance, the form of the interaction is expected to show that autonomy has benefits when KSAs are high but has little or no effect when KSAs are low. In other words, autonomy
will have a positive impact on team performance only to the extent that members have teamwork knowledge, skills, and abilities to respond to such an opportunity. This model is not only intuitively appealing, but has its basis in the theoretical propositions of Peters and O'Connor (1980) and Blumberg and Pringle (1982), who argued for the need to extend the traditional notion of work performance being the product of motivation and ability to include opportunity as an equally important factor. In this context, team autonomy provides the opportunity for people with relevant KSAs to use them, and conversely KSAs provide the means for people to use autonomy to greatest effect.

With regard to strain, the form of the interaction is predicted to show that autonomy has a beneficial effect (i.e., reduces strain) when KSAs are high, but has a detrimental effect when they are low. Specifically, under conditions of greater autonomy (i.e., control or decision-making latitude) team members will experience psychological strain if they are neither competent in their interactions nor possess the skills to manage their work effectively. This proposition is based on the demands-control model of job strain (Karasek, 1979; Karasek & Theorell, 1990) and the wider literature on self-efficacy (e.g. Bandura, 1986).

The Present Study

This study seeks to contribute both to the work design literature and the teamwork-KSA literature. Besides looking at how autonomy and teamwork KSAs, respectively, relate to performance and job strain, the aim of the present study was to test the two aforementioned models empirically. Thus, three hypotheses were tested.

1. Autonomy and teamwork KSAs will be individually related to team performance and member job strain. (This represents a replication of previous studies, for instance Campion et al., 1996.)
2. Teamwork KSAs will mediate the relationship of autonomy both with team performance and member job strain.
3. Autonomy and teamwork KSAs will interact to predict team performance and member job strain.

METHOD

Setting and Sample

The research was conducted in the manufacturing facilities of two medium-sized UK organizations. The reason for involving two organizations was to provide sufficient teams for analytical purposes. Company A makes steel
products, such as rolled bars and sections, for customers throughout Europe, and has some 450 employees. Company B produces photographic paper and film for its home market as well as for export to Japan, the USA, India and Europe, and has about 800 employees. In collaboration with management and technical support staff, shopfloor production teams were selected for the study using several criteria, namely that members were part of a clearly identifiable work unit, were responsible for a discrete aspect of production, and were reliant on each other in order to complete tasks. This process ensured that only legitimate teams (i.e., those that conformed to standard definitions of teamwork) were involved in the study. As recruitment was affected by opportunity (i.e., not all teams were available to take part due to shift systems and manufacturing demands), the full sample comprised 41 teams, with a total of 174 team members (96% participation). Employee participation was voluntary. Twenty-five teams were drawn from Company A (98 employees with 96% average participation); and 16 teams from Company B (76 employees, with 95% average participation). The lowest level of participation for any one team was 63%. For the combined sample, the age of employees (all of whom were male) ranged from 21 to 62 years ($M = 40.93$), the time spent in their current team ranged from 1 to 26 years ($M = 6.78$), and the length of service ranged from 1 to 41 years ($M = 14.72$).

At the time of the study, the practice of affording teams greater autonomy had been in existence for some 15 months. Levels of autonomy, however, varied in both organizations, although each team was minimally responsible for the management of routine task activities. Variation in autonomy was primarily due to managers' preferences and manufacturing demands. Both organizations had invested in training to support team autonomy, including most notably aspects of Total Productive Maintenance that concern fault rectification. Teamwork KSAs, however, were not explicitly targeted.

**Procedure**

The senior author was introduced to the participants in a series of meetings. These provided an opportunity to: discuss teamworking; clarify what participation in the study involved; and emphasize confidentiality (that only the researchers would have access to the data). Measures of teamwork KSAs, autonomy and strain were combined into a single booklet. Booklets were administered during working hours, and were handed to the researcher upon completion.

**Measures**

*Team Autonomy.* The degree to which teams were involved in managing their own work activities was assessed by a three-item scale, based on Little
(1989) and Sprigg, Jackson, and Parker (2000). Items included “Are team members themselves involved in making decisions about setting goals and targets?” and “Are most job-related decisions made by team members rather than by just the shift manager?” The five-point response scale ranged from 1 “not at all” to 5 “a great deal”. Internal consistency reliability (Cronbach’s alpha) was .78. Team scores were calculated as the mean of member scores. The rationale for this was based on the assumption that members would possess similar perceptions of team autonomy. To determine whether the data could be legitimately used in this way, scores for each team were subjected to a test of within-group agreement ($r_{wg}$) (see James, Demaree, & Wolf, 1984, 1993). Averaged across all teams, this gave an $r_{wg}$ coefficient of .80 (93% of teams were at or above the acceptable $r_{wg}$ threshold of .7), signifying a considerable degree of consistency of perceptions among members of the same team. We conducted all analyses using both the full sample ($n = 41$) and a sample excluding teams with an $r_{wg}$ coefficient below the .7 threshold ($n = 38$). As the pattern of findings for both sets of analyses was equivalent, we report findings based on the full sample.

In support of conducting analyses at the group level, it is considered appropriate also to examine between-group variation, to preclude the possibility that a high within-group agreement is merely the result of similar ratings by all employees regardless of team. Analysis of covariance (controlling for company) showed a statistically significant difference across teams ($F = 1.88$, $p < .01$).

**Teamwork KSAs.** The Teamwork-KSA Test, developed by Stevens and Campion (1994, 1999), was used to assess team members’ teamwork knowledge, skills, and abilities. This measure “emphasizes attributes which management can influence (e.g. via selection procedures or training programs), rather than trait or dispositional attributes which are presumed to be more stable characteristics of individuals which cannot be as readily influenced” (Stevens & Campion, 1994, p. 504). The test has 35 multiple-choice items that describe possible team situations, and participants are asked to indicate how they would behave in each case. An example item follows: “Suppose you are presented with the following types of goals. You are asked to pick one for your team to work on. Which would you choose?” The four response options for this question are: A. An easy goal so the team will be assured of reaching it, thus creating a feeling of success; B. A goal of average difficulty so the team will be somewhat challenged, but successful without too much trouble; C. A difficult and challenging goal that will stretch the team to perform at a high level, but attainable so that effort will not be futile; D. A very difficult, or even impossible goal so that even if the team falls short, it will at least have a very high target to aim for. The 35 items are nested under 5 sub-categories. Three concern interpersonal KSAs, namely conflict

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resolution KSAs, collaborative problem solving KSAs, and communication KSAs; and the other two concern self-management KSAs, namely goal setting and performance management KSAs and planning and task coordination KSAs.

As recommended, an overall score for teamwork KSAs was obtained by summing the correct answers, giving a possible range from 0 to 35, with higher scores signifying greater KSA levels. The test authors (Stevens & Campion, 1999) reported an internal consistency reliability (alpha) of .80. Cronbach’s alpha for the present sample was .70. Although it would have been potentially interesting to examine differential effects for the KSA sub-categories, their internal reliabilities were below the acceptable threshold. Therefore, finer-grain analyses using such categories were not appropriate. These findings, however, reflect Steven and Campion’s (1997) recommendation that sub-categories should only be used for assessing training and development needs, not for employee selection purposes (and by implication not for research purposes either).

As referred to above, Stevens and Campion propose that teamwork KSAs are learnable skills. As such, a possibility to consider is that members of the same team possess similar KSAs. Equivalent KSAs within teams could occur, for instance, from less able members “picking up” or acquiring skills from more able ones, or from members jointly acquiring skills as they develop norms about how to carry out their tasks, or from both. This offers an alternative view to the common assumption that KSAs vary within teams. To examine the validity of this possibility, the test of within-group agreement ($r_{wg}$) was used. Averaged across all teams, this gave a coefficient of .83 (90% of teams gave a coefficient at or above the .7 threshold). This suggests that teamwork KSA scores (obtained from individuals) actually represent a team-level variable, and that the mean team KSA score is the most appropriate index for analysis. We thus conducted analyses using the full sample ($n = 41$) and a sample omitting teams with an $r_{wg}$ coefficient below the threshold ($n = 37$). As these gave identical patterns of results, we report findings based on the full sample.

As previously discussed, it is also appropriate to examine between-group variation prior to conducting team-level analyses. Analysis of covariance (controlling for company) showed a statistically significant difference across the teams ($F = 1.60, p < .05$).

**Job Strain.** Job strain was assessed using the short forms of the job-related anxiety and job-related depression scales developed by Warr (1990). Each of these scales has three items (see Mullarkey, Wall, Warr, Clegg, & Stride, 1999). Respondents are asked how much of the time their job has made them feel a particular way, which is indicated by the use of such adjectives as “tense” or “miserable”. Answers are given on a 5-point response scale.
ranging from 1 “never” to 5 “all the time”. As the scales were strongly intercorrelated \((r = .70)\), they were combined to form a single six-item index. Higher scale scores denote greater job-related strain. Cronbach’s alpha was .87. Although team members were asked to rate their own feelings toward work, it was anticipated that they would experience similar levels of strain due to task interdependences and shared responsibilities. Preliminary analyses of the data confirmed this, with the test of within-group agreement \((r_{wg})\) producing an average team coefficient of .86 (93% of teams were at or above the acceptable threshold of .7), indicating similar ratings among members of the same team. As with the teamwork KSA measure, this finding suggests that the scores for job strain (individual-level data) may in fact represent a team-level variable (e.g. levels of strain for members of the same team may collectively change in line with work demands). Thus, to enable subsequent analysis at the team level, an index of team strain was used.

In line with above, we conducted analyses using the full sample \((n = 41)\) and a sample excluding teams with an \(r_{wg}\) coefficient below the .7 threshold \((n = 38)\). The pattern for both sets of analyses was equivalent, therefore we report findings based on the full sample. The test of between-group variance (controlling for company) showed a statistically significant difference across the teams \((F = 1.75, p < .05)\).

**Team Performance.** Team performance was assessed through managerial ratings. These were obtained by using four items from the “work unit effectiveness” (WUE) scale developed by Uhl-Bien and Graen (1998). Items included “How good is the team at achieving its goals?” and “How would you rate the performance of the team as a whole?” Responses were recorded on a five-point response scale ranging from 1 “very poor” to 5 “very good”. Cronbach’s alpha was .86. Managers rated teams at about the same time as employees completed the teamwork KSA test and other measures. The measure was administered in one of three ways, reflecting the preferences and “political sensitivities” of different managers. For 16 of the teams (8 from Company A and 8 from Company B) team performance was calculated as the mean of individual manager ratings (each manager rated the performance of their own team and that of at least two others with which they were most familiar). Inter-rater agreement \((r_{wg})\) among managers rating identical teams was high, producing an average team coefficient of .89 (all teams were above the \(r_{wg}\) threshold of .7). This confirms the relative ease and consistency with which managers were able to discriminate between the performance of teams. For the further 8 teams in company B, performance data were obtained from managers working in groups of 4 to complete the WUE sub-scale. Each management group produced an agreed (consensus) performance score for the teams they dealt with. Finally, performance of the remaining 17 teams in company A was measured by single ratings from
managers who assessed their own teams (4 managers completed the scale). It is important to note that analysis of variance showed no statistical difference between the mean performance ratings obtained by the different methods ($F = 2.17$, ns), signifying that performance data could be treated as a whole.

Although the collection of meaningful objective performance data was not viable across the sample of teams as a whole (there was no common metric applicable to all teams in the sample), such information was available for a sub-sample of 8 teams from Company A. These were teams that worked on the same technology and products, but on different shifts. This provided an opportunity to examine the validity of managers’ ratings of team performance by determining how well these related to actual performance. Reported team performance was derived from individual manager ratings (32 in total); that is, performance for each team was calculated as the mean of 4 independent ratings. Actual performance was tonnes of steel produced during a six-month period prior to the study. Findings showed a close positive association between the two measures, with a rank-order correlation (Spearman’s rho) of .80.

RESULTS

Preliminary Analyses

Potential “Third Factors”. Evaluation of the models required initial consideration of the relationships among the background, predictor and dependent variables, so as to identify any third factors that might affect the results. This was approached initially through an inspection of zero-order correlations among the study variables as shown in Table 1. These showed no relationship of age (team average), length of service (team average), team tenure (average) or team size with KSAs, autonomy, performance or team strain. Company membership, however, had a strong relationship with autonomy and with team strain. Team members in company A reported higher levels of autonomy and lower levels of strain than team members in company B. Thus in subsequent analyses this factor was controlled.

The absence of significant zero-order correlations between background (excluding company membership) and other variables does not, however, preclude the possibility that variables such as team tenure or team size could affect the results. Each background variable therefore was individually included as a control variable in the analyses to examine this possibility (examination of effects of all control variables at the same time was not appropriate because of sample size constraints). As the pattern of findings was the same regardless of which background variable was controlled, the following section presents analyses that only control for company membership.
### TABLE 1
Means, Standard Deviations, and Correlations for Study Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age (team level)</td>
<td>40.92</td>
<td>4.46</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Length of service (team level)</td>
<td>14.79</td>
<td>4.38</td>
<td>0.73**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Team tenure</td>
<td>6.15</td>
<td>3.20</td>
<td>0.19</td>
<td>0.38*</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Team size</td>
<td>4.24</td>
<td>1.41</td>
<td>–0.06</td>
<td>–0.22</td>
<td>–0.05</td>
<td>–</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>5. Company membership</td>
<td>–</td>
<td>–</td>
<td>–0.02</td>
<td>–0.27</td>
<td>–0.15</td>
<td>0.29</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Team autonomy</td>
<td>3.00</td>
<td>0.73</td>
<td>–0.11</td>
<td>0.27</td>
<td>–0.02</td>
<td>–0.08</td>
<td>–0.60**</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Teamwork KSAs</td>
<td>18.75</td>
<td>3.05</td>
<td>–0.20</td>
<td>–0.25</td>
<td>–0.26</td>
<td>0.11</td>
<td>0.05</td>
<td>0.45**</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>8. Team performance</td>
<td>3.80</td>
<td>0.61</td>
<td>0.14</td>
<td>–0.02</td>
<td>–0.12</td>
<td>0.04</td>
<td>–0.43*</td>
<td>0.49*</td>
<td>0.51**</td>
<td>–</td>
</tr>
<tr>
<td>9. Team strain</td>
<td>2.17</td>
<td>0.46</td>
<td>0.03</td>
<td>0.06</td>
<td>0.18</td>
<td>–0.21</td>
<td>0.37*</td>
<td>–0.48**</td>
<td>–0.41**</td>
<td>–0.52**</td>
</tr>
</tbody>
</table>

\( n = 41, * p < 0.05, ** p < 0.01 \).
Main Analyses

All three hypotheses were tested by running two complementary hierarchical regression analyses, each with 4 steps. For regression 1, company membership was entered at step 1, autonomy at step 2, KSAs at step 3 and the interaction term (autonomy $\times$ KSAs) at step 4. Regression 2 was the same except that steps 2 and 3 were reversed, with KSAs entered at step 2 and autonomy at step 3. The results are shown in Table 2, which for economy of presentation integrates the two sets of analyses.

**Hypothesis 1.** The first hypothesis is that higher levels of autonomy and KSAs will be individually associated with greater team performance and lower team strain, respectively. The basic test for this comes from considering step 2 of each of the two regression analyses, in which company membership (dummy coded) was entered as a control at step 1, and either autonomy or KSAs at step 2. Considering autonomy first (row 2 in the body of Table 2), it is evident that this is related as predicted both to team performance ($\beta = .35$, $R^2\Delta = .09$, $p < .05$) and to team strain ($\beta = -.38$, $R^2\Delta = .10$, $p < .05$), accounting for 9 and 10% of the additional variance, respectively. The equivalent analysis for the KSAs variable (row 4) shows this has an even stronger effect, being a predictor of both team performance ($\beta = .53$, $R^2\Delta = .28$, $p < .01$) and team strain ($\beta = -.43$, $R^2\Delta = .19$, $p < .01$), accounting for 28 and 19% of additional variance, respectively. Thus, there is support for hypothesis 1 since both autonomy and KSAs relate to both outcomes respectively. This confirms previous research dealing with these variables separately. Nonetheless, it is evident that KSAs are more strongly related to performance than autonomy (Hotelling’s $t = 3.02$, $p < .01$), and this opens up the possibility that KSAs may explain the relationship of autonomy with
the outcomes. Since this issue is central to hypothesis 2, the relevant findings are presented in the next section.

**Hypothesis 2.** The premise of hypothesis 2 is that KSAs will mediate, that is account for, the relationship of autonomy with performance and strain. This was tested using the rationale set out by Baron and Kenny (1986). This involves showing that where a chosen variable (in this case autonomy) has a simple effect on an outcome, the effect is removed by the prior inclusion in the regression equation of the mediating variable (in this case teamwork KSAs). The relevant findings are shown in Table 2. As already established from the results for hypothesis 1, autonomy (controlling for company membership) is related to both outcomes (row 2). The additional evidence required to establish mediation comes from regression 2. This confirms that once the effect of the hypothesized mediating variable (KSAs) is removed (see row 5), there is no residual statistically significant relationship either between autonomy and performance ($\beta = .02, R^2_\Delta = .00, \text{ns}$) or between autonomy and strain ($\beta = -.12, R^2_\Delta = .01, \text{ns}$). Thus the inclusion of KSAs effectively accounts for the relationship of autonomy with the outcomes, consistent with hypothesis 2.

**Hypothesis 3.** The final hypothesis is that autonomy and KSAs interact to predict effectiveness and strain. The standard test for such an interaction is moderated regression, covered in our analysis through entering the cross-product of autonomy and KSAs into the equation at step 4, after the main effects of the independent variables have been removed (all variables were standardized prior to analysis). The results are shown in the final row of Table 2 and show no statistically significant effect for the cross-product term for either performance ($\beta = .01, R^2_\Delta = .00, \text{ns}$) or strain ($\beta = .19, R^2_\Delta = .03, \text{ns}$). Thus, hypothesis 3 is rejected.

**Supplementary Analyses**

Further analyses were conducted to: (1) investigate a plausible alternative model of the relationship of autonomy and KSAs with the outcomes; (2) determine whether the effects for performance and strain revealed by the main analyses were independent of each other; and (3) examine whether the pattern of findings differs according to company.

1. Although lacking the degree of theoretical justification of the main models, a plausible and logically possible alternative model is that autonomy mediates the relationship of teamwork KSAs with performance and member strain. The rationale for one aspect of this proposition, that autonomy will be related to the outcomes, has already been discussed in the Introduction; and empirical evidence that this is the case in the present sample is apparent.
in Table 2 (row 2). The part that requires further consideration is that KSAs are related to autonomy. The conceptual basis for this view can be traced to Graen’s (1976) discussion of “role-making” within organizations. His argument is that work roles are to some extent negotiated. Managers with more able employees are likely to afford them more autonomy and, correspondingly, employees shape their work to fit their individual competencies. Similarly, Parker, Wall, and Cordery (2001) suggest that “more proactive individuals shape and expand their job content”. The evidence that this could be the case is shown by the correlation of $r = .45$ between autonomy and KSAs (see Table 1). Thus the basic requirements for mediation are met, and it only remains to determine whether the observed relationships between KSAs and the outcomes are removed when autonomy is controlled. The relevant findings are included in the previous analyses. Given that KSAs relate to both performance and strain even after autonomy has been entered into the regression equation (see Table 2, row 3, where $\beta = .54$, $R^2\Delta = .20$, $p < .01$ and $\beta = -.37$, $R^2\Delta = .09$, $p < .05$, respectively), this alternative model is rejected. Importantly, this finding provides further evidence in favor of the predicted mediation model. Nonetheless, to test the direction of causality implied by the predicted model, data collected longitudinally are necessary (see Discussion).

2. In the analysis so far, performance and strain have been treated as distinct outcome variables. That assumption, however, can be challenged. It is not unreasonable to suggest that in teams experiencing greater strain, performance may suffer. It is equally plausible to assume that teams performing better might experience less strain, because successful output is likely to reduce negative feedback and work pressure. That these possibilities could apply in the present study is suggested by the data presented in Table 1, where performance correlates $-.52$ with strain ($p < .01$).

To examine this issue, that performance may mediate the effects of KSAs on strain, or strain may mediate the effect of KSAs on performance, two further hierarchical regression analyses were conducted. In the first, performance was the dependent variable, company membership was entered into the regression equation at step 1, and both strain and KSAs at step 2. In the second regression, strain was the dependent variable, company membership was entered at step 1, and both performance and KSAs at step 2. The results are presented in Table 3. These show that KSAs are related to performance having controlled for strain ($\beta = .45$, $R^2\Delta = .16$, $p < .01$), and that strain has no relationship with performance once KSAs are controlled ($\beta = -.20$, $R^2\Delta = .03$, ns). Furthermore, they reveal that neither KSAs nor performance is related to strain ($\beta = -.30$, $R^2\Delta = .06$, ns, and $\beta = -.25$, $R^2\Delta = .03$, ns, respectively) where the other is controlled. This indicates significant overlap (shared variance) between performance and KSAs in predicting strain. The results also reveal there is no statistically significant relationship
between performance and strain once the effects of KSAs have been removed. In other words, the link between performance and strain evident from the zero-order correlation is partially due to the fact that they have a common source.

3. In order to achieve an adequate sample size we combined data from two companies, and included company membership as a control variable to eliminate any spurious effects from that source. Nonetheless, it is important to determine whether the findings obtained for the sample as a whole are equivalent within the two company sub-samples (rather than due to a strong effect in one sub-sample, and none in the other). To investigate this possibility, we conducted moderated regression analyses, entering an interaction term for autonomy X company, and for KSA X company, to their respective main effects as predictors of performance and strain. Findings showed that in every case the interaction term was non-significant, that the results apply to both companies.

### DISCUSSION

The aim of the present study was to test alternative hypotheses of the relationship of team autonomy and members’ teamwork KSAs on the one hand, with team performance and employee job-related strain on the other. The findings support hypothesis 2, showing that KSAs mediate the relationship of autonomy with both performance and strain. These findings therefore indicate that support for hypothesis 1, that team autonomy and KSAs are individually related to performance and strain, is overly simplistic and potentially misleading. No support was found for hypothesis 3, that autonomy interacts with KSAs to predict performance and strain.

The findings have both important theoretical and practical implications. From a theoretical viewpoint, the study supports propositions concerning

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**TABLE 3**

Results of Regression Analyses Testing Effects of KSAs on Performance Controlling for Strain, and on Strain Controlling for Performance

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>Performance</th>
<th>Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>R²Δ</td>
<td>β</td>
</tr>
<tr>
<td>1</td>
<td>Company membership</td>
<td>−0.43*</td>
<td>0.19</td>
</tr>
<tr>
<td>2</td>
<td>Strain/performancẽ</td>
<td>−0.20</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>KSAs</td>
<td>0.45**</td>
<td>0.16</td>
</tr>
</tbody>
</table>

* Value at step denotes unique variance explained by variable. ẽ Strain was included where performance was the dependent variable; and performance where strain was the dependent variable.

* p < 0.05, ** p < 0.01.
the role of cognitive-based mechanisms in teamwork (e.g. Stevens & Campion, 1994); that is, findings show that the association of team autonomy with team performance and strain can be accounted for by teamwork KSAs. This perspective complements a growing body of work suggesting cognitive processes are an important mechanism underpinning work redesign effects (e.g. Frese & Zapf, 1994; Herzberg, 1966; Jackson & Wall, 1991; Lawler, 1992; Leach, Jackson, & Wall, 2001; Wagner et al., 1997), over and above the motivational processes traditionally assumed (e.g. the Job Characteristics Model, Hackman & Oldham, 1976).

In terms of practical recommendations for enhancing performance and reducing strain, the present findings support the view that increasing autonomy for teams could be a worthwhile strategy from both a team and individual perspective. Given team autonomy is associated with KSAs, this may be a major lever through which to improve such skills. In other words, through hands-on experience of managing work activities, it is plausible that ineffective behaviors are abandoned, and more effective KSAs acquired, as members begin to realize how their actions (or lack thereof) relate to the goals for which their team is responsible (e.g. meeting production targets, quality standards). The particular value of autonomy as a means of increasing KSAs is likely to be because it enables active learning and rehearsal of effective skills in the workplace. As such, a possibility to be considered is that autonomy represents a complementary strategy for enhancing teamwork KSAs along with training.

Although we used teams in genuine production settings, the study has several limitations, of which the following six are among the most important. The first concerns generalizability. While KSA scores of the present study are comparable to those obtained for production employees in other manufacturing settings, we do not know the extent to which the findings can be extended to other types of team and environment, and thus constructive replications are necessary.

The second limitation is that the study provides no basis for causal inference, due to its cross-sectional design. To be sure, if the directions of causality assumed in the causal models proposed were correct they should be evident in cross-sectional data; and the absence of such relationships would contradict causal assumptions. Our finding of such relationships, however, is not proof of causality. Thus there is a need for complementary longitudinal intervention studies. Given the particular characteristics of the model supported in this investigation, such a study should involve the enhancement of autonomy in some teams and of teamwork KSAs in others (as well as a no intervention control condition). Although it may be impossible to calibrate those interventions to be of equal magnitude, and hence a direct comparison of effects would be difficult, such longitudinal research would allow investigation of the sequence of causality assumed.

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The third limitation concerns the relatively small sample size ($n = 41$), which affects the power to detect multivariate effects. This does not appear problematic with regard to the positive findings for hypothesis 2, since the effect sizes of interest were quite substantial and sample size is taken into account in determining statistical significance. However, the small sample size does reduce confidence in negative outcomes. As such, it is appropriate to treat the absence of support for hypothesis 3, which posits an interaction between autonomy and KSAs as predictors of team effectiveness, with caution. This is because moderated regression can be insensitive to such effects, relative to main effects, in smaller samples (Aiken & West, 1991; Busemeyer & Jones, 1983). Nonetheless, given that the interaction effect for performance explained 0% of the variation between teams, and the effect for strain a modest 3%, it is reasonable to conclude that the findings offer little support for the moderation model.

The fourth limitation relates to the measurement of team performance. Although we asked managers to rate teams, uncertainty exists concerning the objectivity of this method. For instance, the quality of the working relationship that a manager has with his/her team may affect perceptions of performance and, concerning multiple ratings, managers may rate their own teams more favorably than those of others. As such, it would have been preferable to base team performance on company records. This, unfortunately, was not possible for the entire sample in the present study. Future research should consider in detail the measurement of performance from the outset, to enhance both the reliability of findings and strength of recommendations.

The fifth limitation concerns the scope of the study; that is, it focused on the relationship between just two characteristics (autonomy and teamwork KSAs) and two outcome variables (team performance and member job strain). Compared with more broadly conceived studies (e.g. Campion et al., 1996; Cohen et al., 1996), the present investigation therefore does not provide such comprehensive coverage of teamwork. Nevertheless, the study’s narrow focus can be regarded as a strength in that broader studies often group related variables together, thereby precluding finer-grain analysis of the type reported here. Thus, studies such as ours have a key role in understanding the relationship between discrete determinants of team effectiveness.

Finally, the question of the construct validity of the KSA test needs to be considered. Thus far we have assumed this is an adequate measure of teamwork knowledge, skills, and abilities. In developing the test, however, Stevens and Campion (1999) reported relatively strong relationships with more general measures of cognitive ability (in two small samples). This raises the possibility that it is cognitive ability, rather than teamwork KSAs per se, that links autonomy to performance. More specifically, if cognitive ability led to better performance and also led managers to afford the teams with more able employees greater autonomy, then it would give a pattern of results identical to those obtained consistent with a mediation effect.
That possibility cannot be precluded, though it does not seem particularly plausible in the present context. This is so for two reasons. First, in terms of face validity, the KSA test is manifestly about teamwork skills rather than general cognitive ability. Items are concerned with awareness of appropriate behaviors in team situations rather than being tests of numerical, verbal or spatial reasoning. Second, Stevens and Campion (1999) demonstrated that the KSA test explained teamwork performance and overall job performance beyond that accounted for by aptitude tests (a statistically significant 8% and 6% increase in explained variance, respectively). These gains are typical of increases in predictive validity (over general mental abilities) for other personnel measures (e.g. job knowledge tests, job tryout procedure, reference checks) in relation to overall job performance, as shown by a major meta-analytical study (Schmidt & Hunter, 1998). Nevertheless, there are doubts about construct validity, and this reinforces the call above for longitudinal change studies, in which, of course, any effects of cognitive ability would be held constant.

In addition to providing an opportunity to examine conceptual and methodological issues, change studies would also enable an investigation of the acquisition of KSAs over time and of the relationship between personality and KSAs. Following an increase in autonomy, it would be informative to examine the extent to which KSAs develop either collectively (i.e., an immediate improvement across all KSAs) or sequentially (i.e., in a stage-like manner). In terms of the latter, a number of different configurations are plausible, for instance: an initial improvement in interpersonal KSAs (e.g. as interactions between members increase) followed by gains in task management KSAs (as members learn to manage work tasks and duties), or vice versa. Importantly, this line of inquiry could also attempt to examine the point at which KSAs (in terms of their development) begin to mediate the relationship of autonomy with performance. (NB: An examination of sub-category reliability, see Method, suggests that the KSA test may not be an appropriate measure for investigating the development of specific teamwork skills.)

Following enhanced autonomy, it would also be of interest to examine whether aspects of personality, such as agreeableness, affect KSA acquisition. An issue to consider, for example, is whether more agreeable members, those with a propensity to get on well with others, acquire KSAs at a faster rate than others.

CONCLUSION

This study sought to address a substantive deficiency in teamwork research to date, by examining how team autonomy together with teamwork KSAs relate to team performance and member job strain. Our findings are
consistent with the view that the link between team autonomy and effectiveness is mediated by teamwork KSAs, and this has important implications for researchers studying team design and for practitioners interested in taking a systemic perspective on improving team performance and decreasing team-member strain.

REFERENCES


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