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Sharing leadership behaviors in virtual teams: effects of shared leadership behaviors on team member satisfaction and productivity

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Abstract

Purpose – Virtual collaboration in teams becomes increasingly popular at work. With the advantages of working in virtual teams come leadership challenges for which the shared leadership theory is discussed as a potential solution. While previous empirical studies investigating shared leadership in virtual teams generally confirm positive effects on team outcomes, this study aims to investigate in detail the leadership behaviors that are typically shared in these settings and how these shared leadership behaviors affect individual level outcomes.

Design/methodology/approach – Individuals from different teams participated in a questionnaire study (n = 411). Structural equation modeling was used to assess the effects of shared task- and relations-oriented leadership behaviors on team member's subjectively perceived productivity and satisfaction with leadership.

Findings – Results indicate that shared task-oriented leadership behaviors have a significant positive effect on subjectively perceived productivity and satisfaction with leadership, while relations-oriented leadership behaviors have a significant negative effect. A hypothesis stipulating a moderating effect of task interdependence was not confirmed.

Practical implications – Practical implications include that in virtual teams with hierarchical organizational structures, it may be recommended that task-oriented leadership behaviors are shared among team members, whereas relations-oriented leadership behaviors should remain the responsibility of the official leader.

Originality/value – The findings complement previous research with new insights on behavioral dimensions of shared leadership and their effects on outcomes on the level of the individual.

Keywords Shared leadership, Virtual teams, Leadership behaviors, Team member satisfaction, Team member productivity

Paper type Research paper

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Introduction

The digital transformation is creating new design options for an economic, flexible and people-oriented organization of work (Mütze-Niewöhner *et al.*, 2022). Central to this is the continuous development of digital information and communication technologies, which enable a team to communicate and collaborate with each other from any location and at any time (Foster *et al.*, 2015). Until recently, these possibilities were mainly used by globally distributed teams, but especially since the outbreak of the COVID-19 pandemic, regional teams are also increasingly working together virtually, which is described as a change of mindset currently taking place in the working world (Costa *et al.*, 2021; Kozlowski *et al.*, 2021). Because of positive experiences for organizations, teams and individuals, like saving resources and greater flexibility on different levels, virtual collaboration will be indispensable in the future despite existing local proximity. Therefore, hybrid solutions in particular – partly on-site, partly virtual – are currently regarded as future forms of collaboration in the office context (Klonek *et al.*, 2021).

However, in addition to positive experiences, forms of virtual collaboration also bring challenges for team members and their leaders, such as overcoming communication barriers, building trust or maintaining team cohesion (Holton, 2001; Morrison-Smith and Ruiz, 2020). Therefore, situationally appropriate leadership behavior is crucial for overcoming these challenges, so that team members feel well supported on a task and relationship level (Bell and Kozlowski, 2002; Kahai *et al.*, 2012; Malhotra *et al.*, 2007).

Previous research results show that especially transformational leadership as well as leadership approaches, where leadership responsibilities are shared among more than one person, play a central role in successfully leading a virtual team (Purvanova and Bono, 2009; Rybnikova and Lang, 2021). Therefore, the concept of shared leadership, whereby team members influence each other to achieve a common goal, is discussed as a solution approach of overcoming leadership challenges in context of virtual teams. Empirical findings support a positive impact of shared leadership on team outcomes in a virtual context (Drescher and Garbers, 2016; Hoch and Kozlowski, 2014; Hoegl and Muethel, 2016; Muethel *et al.*, 2012; Robert and You, 2018).

As these studies have so far examined shared leadership in virtual teams primarily from a structural perspective, there is a need for further research on behavioral dimensions of leadership to get more insights on which exact leadership behaviors are typically shared in virtual settings and which should continue to be adopted by the leader. Initial studies examining other than virtual team settings indicate that research on behavioral dimensions of shared leadership provides relevant insights into which task- and relations-oriented leadership behaviors are shared within the team (Sweeney, 2022) and how they influence team performance (Han *et al.*, 2021). Whereas Sweeney (2022) did a qualitative analysis on shared leadership behaviors emerging in teams, Han *et al.* (2021) showed that sharing relations-oriented leadership (SROL) behaviors has positive effects on team outcomes mediated through team psychological capital, whereas sharing task-oriented leadership (STOL) behaviors has negative effects on team outcomes. More research is needed following these studies to gain further insights into how sharing leadership behaviors can have different effects on outcomes, especially for virtual team settings, as there are so far no studies examining behavioral dimensions of shared leadership in this context. Therefore, the extension of this research on behavioral dimensions is necessary to contribute to the existing leadership literature as well as to provide practical implications for applying the concept of shared leadership in virtual teams.

Further, previous research of shared leadership mostly examines the impact at team level, not individual level. Particularly, in the context of virtual teams, where one of the

challenges is to ensure that team members can work productively and satisfactorily even with little personal contact to other team members, it is important to determine to what extent the concept of shared leadership has an impact on individual team members. Therefore, there is also a need to expand shared leadership research to examine the impact of shared leadership at the individual level (Scott-Young *et al.*, 2019).

Last, when studying shared leadership in virtual settings, the team task interdependence in virtual teams should be considered, as this increases leadership challenges. As previous studies confirmed that task interdependence moderates the relationship between shared leadership and team outcomes (Nicolaides *et al.*, 2014), this moderator variable should be considered for studies on individual level as well.

Therefore, the study examines the following questions:

Q1. What is the impact of sharing task-oriented leadership behaviors on individual team members?

Q2. What is the impact of sharing relations-oriented leadership behaviors on individual team members?

Q3. Is the influence moderated by the team task interdependence?

Given the challenges that many leaders experience in leading virtual teams and the attributed high potential of the shared leadership approach in overcoming them, there is a need for applied empirical research that expands the current understanding of shared leadership in virtual teams. Hence, the purpose of this research is to examine the shared leadership theory for virtual work contexts in more detail with regard to the leadership behaviors that are being shared and the effects on the individual team members. The resulting findings are discussed to the extent to which shared leadership behaviors should be considered as a concept to usefully complement hierarchical leadership concepts. Further, practical implications for the application of shared leadership in virtual teams can be derived.

Virtual teams

The virtuality of a team is determined in particular by the core dimensions of geographic distribution and use of digital information and communication technologies (Bell and Kozlowski, 2002; Gilson *et al.*, 2014; Hertel *et al.*, 2005; Kirkman and Stoverink, 2021; Townsend *et al.*, 1998). The geographic distribution of a virtual team includes how far apart team members are spatially, whether they work in the same or shifted time windows and how the team is structurally distributed across the different locations (Foster *et al.*, 2015; O'Leary and Cummings, 2007). Further, virtual teams differ in the extent to which they use digital information and communication technologies instead of face-to-face meetings. If both core dimensions are considered, different forms of virtual teams can be arranged on a continuum (Gibson and Gibbs, 2006). While in the classic sense a virtual team is still thought of as a team distributed across the globe, the term may also refer to regionally based teams, in which some or all team members work from home or other places outside the office (Klonek *et al.*, 2021).

The possibilities and associated limits of virtual collaboration are currently being reexamined and are thus increasingly becoming a fixed component in the context of office work (Handke *et al.*, 2020). It enables organizations to recruit experts from different regions as employees as well as saving resources on travel and office costs (Ferreira *et al.*, 2021; Henttonen and Blomqvist, 2005). Teams can coordinate more flexibly in terms of time and location, while still sharing information transparently through digital capabilities

(Kahai *et al.*, 2012). For the team members themselves, location-independent working enables an easier work–life balance (Hill *et al.*, 2003).

Next to the advantages, however, virtual teams also face challenges that are largely the same for the various forms of virtual collaboration, in addition to a few specific features, such as cultural diversity in globally distributed teams or the risk of isolation in the home office (Kozlowski *et al.*, 2021). Overall, the central issue is bridging the lack of personal contact so that trusting collaboration can be established and maintained despite the absence of face-to-face conversations and nonverbal communication (Rybnikova and Lang, 2021). To make good use of the potentials of virtual collaboration, management approaches must be aligned accordingly, with the leadership of virtual teams playing an important role in overcoming the challenges and making virtual teamwork effective (Kahai *et al.*, 2012).

Leadership in virtual teams

The leadership of virtual teams plays a central role in overcoming the challenges of remote collaboration and ensuring team performance (Kahai *et al.*, 2012). The digital transformation and the accompanying increase in geographically and temporally distributed team structures place new demands on leadership (Wald, 2021). As early as the 2000s, the term e-leadership was defined and the leadership of virtual teams was researched along with it. E-leadership describes that social influence on team members to achieve a common goal must be media-mediated (Avolio *et al.*, 2000). This definition initially implies that leadership and the tasks associated with it do not change *per se*, only that they are carried out via digital media. But, early on, there was a new emphasis on challenges that leaders must overcome when their team members are not working on site. These include building and maintaining trust, managing diversity in the team, organizing virtual meetings, monitoring work progress with the use of digital media, improving the team's external image and valuing and building motivation among individual team members, even without face-to-face contact (Malhotra *et al.*, 2007). It has been suggested that overcoming these challenges may be achieved through the correct use of digital information and communication channels, the establishment of rules and norms and the development of a shared knowledge base as well as trust and team cohesion (Kozlowski *et al.*, 2021).

Previous studies have examined several approaches of leadership styles and concepts that can be used to meet the challenges of virtual leadership (Wald, 2021). Initial studies particularly indicate that transformational leadership style has a positive impact on team performance in a virtual context (Balthazard *et al.*, 2009; Purvanova and Bono, 2009; Yoo and Alavi, 2004). By building a leadership relationship at a deep emotional level, transformational leadership style inspires enthusiasm for values, goals and tasks among team members (Bass and Avolio, 1997), thus enabling the development of trusting collaboration, which is especially important in the absence of control in the virtual environment. However, recent studies additionally indicate that the communication needs that exist in transformational leadership are often more difficult to realize via digital media, and thus, transactional leadership behaviors with clearly defined objectives may also be appropriate, especially in the virtual context (Andressen *et al.*, 2011; Eisenberg *et al.*, 2019; Hill and Bartol, 2016; Howell *et al.*, 2005). It turns out that overcoming the challenges of leading virtual teams remains difficult, especially as long as leadership approaches imply that leadership responsibilities lie with one person. The local distance can be bridged, for example, by having team members take on leadership tasks on site that would otherwise fall to the manager, such as training a new team member (Mayer, 2021). Thus, leadership approaches, where leadership responsibility is shared among more than one person, are gaining popularity for overcoming leadership challenges in the virtual context (Wald, 2021).

Shared leadership in virtual teams

The most widely used definition of shared leadership theory, on which this study relies, defines shared leadership as a group level leadership phenomenon in which team members influence each other to achieve a common goal (Pearce and Conger, 2003). D'Innocenzo *et al.* (2016) describe shared leadership as a team phenomenon that is emergent and dynamic. The concept of shared leadership can take different forms. Leadership roles and functions can be distributed to individuals on the team or equally. Further, there are possibilities of shared leadership in formal as well as informal team structures. The distribution of leadership responsibilities among several people does not initially mean that there is no longer a formal leader. It can also imply that responsibility is dynamically divided and team members are motivated to take on leadership responsibilities depending on the situation and to step back in others to hand over this role to team members (Serban and Roberts, 2016; Stewart *et al.*, 2011). Thus, a formal leader may also share leadership responsibilities with other team members, which is particularly useful when a leader is heavily dependent on the knowledge and expertise of individual team members (Bligh *et al.*, 2006). However, shared leadership is also described as an informal and emergent phenomenon, as it for example occurs when formal leadership is lacking (Rybnikova and Lang, 2021). Furthermore, management concepts are on the rise in which the team's self-organized mode of operation is emphasized, hierarchies are dismantled, and clear roles and their responsibilities are defined in the course of this, so that leadership in the sense of shared leadership also occurs here (Gronn, 2002). To date, there are four metaanalytic reviews that overall confirm a positive relationship between shared leadership and team outcomes (D'Innocenzo *et al.*, 2016; Nicolaides *et al.*, 2014; Wang *et al.*, 2014; Wu *et al.*, 2020). Individual studies of shared leadership have been conducted in different contexts and especially focus on team antecedents, facilitators and outcome variables (Wu *et al.*, 2020).

The challenges experienced by virtual teams because of the distribution of location and time, place new demands on leadership. It was recognized early on that the shared leadership approach offered a way to address these challenges. Pearce *et al.* (2004) derived the assumptions from a study at that time, which proved that in computer-mediated collaboration team members participate more in decision-making processes (Weisband *et al.*, 1995). They themselves subsequently proved in a study that sharing leadership in virtual teams was a better predictor of team outcomes than vertical leadership (Pearce *et al.*, 2004). Virtual teams primarily face the challenge of communication, which is largely asynchronous and digitally mediated. In addition, virtual teams often work on complex cognitively demanding tasks that require a high level of self-management by team members and thus also argue for shared leadership (Bell and Kozlowski, 2002). Leaders of virtual teams need to ensure productivity, which they can do by introducing shared leadership so that the team can self-organize to a higher degree (Kozlowski *et al.*, 2021). Studies on shared leadership in virtual teams confirm that teams benefit more from shared leadership than hierarchical leadership, especially in terms of performance (Drescher and Garbers, 2016; Hoch and Dulebohn, 2017; Hoch and Kozlowski, 2014; Hoegl and Muethel, 2016; Nordbäck and Espinosa, 2019; Muethel *et al.*, 2012; Pearce *et al.*, 2004). In addition, single studies recognized that in virtual teams shared leadership has a positive effect on satisfaction (Robert and You, 2018), a positive effect on creativity (Han *et al.*, 2020; Xie *et al.*, 2021) and a positive effect on the sense of belonging to a group and the fair distribution of responsibility and workload (Yilmaz *et al.*, 2020).

Overall, shared leadership is mostly analyzed either from the perspective of a social network, which answers the question of who leads, or from the perspective of leadership style, which answers the question on what form of leadership style is being used

(Carson *et al.*, 2007; Zhu *et al.*, 2018). Sweeney (2022) captured the frequency of shared leadership behaviors taken over by team members and found that task-oriented leadership behaviors like coordinating leadership tasks are shared among team members, as are relations-oriented leadership behaviors such as providing support and consideration to others within a team. A study by Han *et al.* (2021) found that STOL tasks is negatively associated with team performance, while SROL tasks is positively associated with team performance mediated through team psychological capital, which describes a form of job and personal resources.

To expand on the study of behavioral dimensions of shared leadership theory, the leadership behavior theory is providing a theoretical framework. It focuses on leadership behaviors and their impact on leadership effectiveness. These leadership behaviors are usually classified into task- and relations-oriented leadership behaviors (Yukl, 2013). A leadership taxonomy describes relevant task- and relations-oriented leadership behaviors (Yukl *et al.*, 2002). By task orientation, Yukl *et al.* (2002) understand that a leader achieves goals efficiently and reliably together with his team members through his corresponding behavior. This includes leadership behaviors such as task clarification, task planning, supervision and problem-solving. Through relations-oriented leadership behavior, a manager supports team members, points out development opportunities and gives recognition. Studies confirm a significant impact of task- and relations-oriented leadership behaviors on team outcomes (Borgmann *et al.*, 2016; Brown *et al.*, 2021; Judge and Piccolo, 2004; Yukl, 2012; Yukl *et al.*, 2019). Early participative leadership models take up task-oriented leadership tasks especially and examine the extent to which decision-making processes in particular can be delegated to team members (Tannenbaum and Schimdt, 2016; Vroom, 2000). Their studies show that depending on the given situational factors, the appropriate degree of delegation leads to higher decision quality and employee satisfaction (Paul and Ebadi, 1989; Pasewark and Strawser, 1994). Building on leadership behavior theory, Grille and Kauffeld (2015) developed a questionnaire to assess successful shared leadership behavior, including task- and relations-oriented leadership behaviors.

Another angle to expand the holistic understanding of the shared leadership theory is to examine the effects of shared leadership on individual level outcomes (Scott-Young *et al.*, 2019). While most studies have focused on the impact on team level outcomes, not many studied the effects of shared leadership on individual level variables such as attitudes, performance and skill development (D'Innocenzo *et al.*, 2016). There are only few studies that consider individual attitudes like satisfaction (Robert and You, 2018; Wood and Fields, 2007) or individual job performance (Drescher and Garbers, 2016; Zhang *et al.*, 2012) as outcome variables. More research on individual level is needed because leadership of virtual teams is not only about ensuring the functionality of the team as a whole (Liao, 2017) but also that each individual team member can work productively and satisfactorily under the challenges of distributed collaboration (Hill and Bartol, 2016). Since previous studies confirm that shared leadership has a positive impact on team performance (Nicolaides *et al.*, 2014), this study expands the research context by investigating whether shared leadership also has a positive impact on subjectively perceived productivity in virtual teams. Further, Robert and You (2018) have studied a mediated influence of shared leadership on individual satisfaction in virtual teams, which is why they propose that there is a need for further research if shared leadership leads to team member satisfaction.

Thus, for the approach of shared leadership in the virtual context, which is generally recognized as positive, there is a need to extend the holistic understanding by investigating which leadership behaviors can be shared and how it affects individual team member's subjectively perceived productivity and satisfaction with leadership. Based on the research

question derived from the current state of research on behavioral dimensions of shared leadership and the effect on individual level outcome, the following hypotheses are postulated for shared leadership in virtual teams:

H1. Sharing task-oriented leadership behaviors has a positive association with subjectively perceived productivity of team members.

H2. Sharing task-oriented leadership behaviors has a positive association with team member satisfaction.

H3. Sharing relations-oriented leadership behaviors has a positive association with subjectively perceived productivity of team members.

H4. Sharing relations-oriented leadership behaviors has a positive association with team member satisfaction.

Task interdependence moderating shared leadership in virtual teams

Task interdependence is defined as the degree to which team members are dependent on other team members to complete their own tasks (Bishop and Dow Scott, 2000). These task workflows can be organized parallel, sequential, reciprocal or complex (Bell and Kozlowski, 2002; Van De Ven, *et al.*, 1976). Parallel tasks can still be processed well asynchronously and independently of other team members; in synchronous or reciprocal task processing, the employees are strongly bound in terms of time to the upstream and downstream process steps (Bell and Kozlowski, 2002). There is a risk of creating a bottleneck, so good communication regarding progress and possible delays between the individual work steps is required. This is especially critical when the people involved in the process are not in the same place. Spontaneous coordination is more difficult and errors or delays might be detected later. As task complexity increases, team task interdependence becomes more dynamic and individual process steps have more than one link to others. This means that tasks are no longer organized in a strictly linear way, so there is especially a high need for coordination of work processes. With the recent increase in virtual collaboration even among teams that previously worked together on-site, it is important to consider their task interdependence within the team, when finding solutions how to bridge the distance through good organization and leadership. Studies confirm that task interdependence has a moderating influence on the effect of leadership on team performance in virtual context (Hertel *et al.*, 2004; Pearce *et al.*, 2004). Thus, the greater the complexity of a workflow within a team, the more challenging the leadership (Kozlowski *et al.*, 2021). Studies show that teams with high task interdependence are more productive with forms of leadership that empower team members and allow high autonomy (Parker, 2014). Pearce *et al.* (2004) found that high task interdependence in a team favors the benefits of shared leadership. This is confirmed in metaanalyses on shared leadership that task interdependence moderates the relationship between shared leadership and team outcomes (Nicolaides *et al.*, 2014; Wu *et al.*, 2020). The extent to which task interdependence matters in the virtual context and moderates the influence of sharing task- and relations-oriented leadership behaviors on team member productivity and satisfaction (Figure 1) will be examined testing the following hypotheses:

H5. Task interdependence accentuates the positive association between shared task-oriented leadership behaviors and perceived productivity of team members.

H6. Task interdependence accentuates the positive association between shared task-oriented leader-ship behaviors and team member satisfaction.

H7. Task interdependence accentuates the positive association between shared relations-oriented leadership behaviors and subjectively perceived productivity of team members.

H8. Task interdependence accentuates the positive association between shared relations-oriented leadership behaviors and team member satisfaction.

Method

Sample and procedure

Because of the research question, individuals from different teams were surveyed in the context of this study. Up to now, the impact of shared leadership has been assessed at the team level in particular, so surveying only individual team members across many teams provides a new perspective. The study was conducted as an online survey and a market research institute was commissioned with the acquisition of participants. Participants were informed about the reason for the survey, how anonymity would be ensured and how the data would be stored. It was emphasized that answering the questions was voluntary. Participants had to be older than 18, employed and working in an office job. Furthermore, they had to be part of a team and were not allowed to hold a management position. The data was collected in June 2021, when working in home offices had already been recommended and implemented in many organizations in Germany for approximately a year because of the pandemic. In total, 705 persons completed the questionnaire (response rate 89.58%). After the exclusion of unserious data sets (Leiner, 2013; Schonlau and Toepoel, 2015) and selecting those who had been working fully or partly in home offices since at least the start of the pandemic, 411 (200 males, 211 females, 0 nonbinary) of the participating individuals were included in the analysis. Participants were on average 42.5 years old (SD = 11.61 yrs.). The location distribution of the respondents' teams was composed of 307 teams having team members who have the option to work in a home office, whereas 104 teams were distributed across multiple locations. The teams in which the participants work were organized by a classic project management format for 198 individuals, agile for 85 individuals and a hybrid format for 128 individuals. Table 1 presents the local distribution in combination with the project management form. Of the 411 individuals, 279 indicated that they had a direct manager, 81 multiple peer managers, 34 no direct manager and 17 individuals did not assign themselves to any of the management structures.

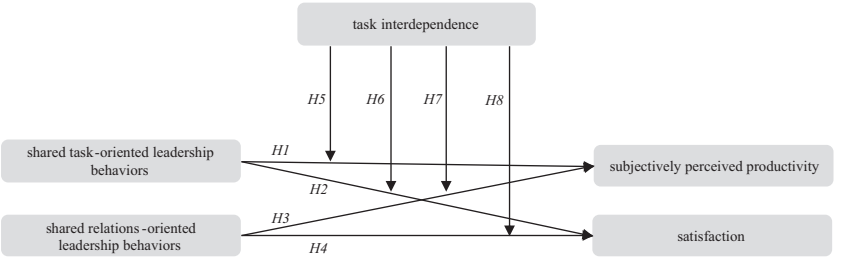


Figure 1.
Proposed model of shared leadership behaviors, outcomes and moderator

Measures

A full list of items used in this study is presented in the Appendix. Items were mostly assessed on a five-point Likert scale. Specifics for measuring leadership behaviors are explained below.

Measurements of shared leadership behaviors

In this study, shared leadership was captured with a questionnaire that focuses on observable behaviors to gain a clearer understanding of the effects of the adoption of specific leadership behaviors by team members. The focus here is primarily on task- and relations-oriented leadership behaviors, the separate consideration of which is established in leadership research (Fleishman, 1953; Hersey *et al.*, 2013; Yukl, 2012). Items were formulated for this study that align closely with the task- and relations-oriented leadership behaviors listed in Yukl's taxonomy of leadership, to assess what explicit leadership behaviors are adopted by team members (Appendix 1). They were queried with the following wording: "By whom are the following tasks and behaviors adopted when working together on your team?" For the task orientation, for example, "defining action steps for task completion" was queried and for the relationship orientation, "praising effective performance." A five-point bipolar scale was used (1 = taken over exclusively by a manager; 2 = taken over predominantly by a manager; 3 = taken over equally by team members and a manager; 4 = taken over predominantly by team members; 5 = taken over exclusively by team members). To ensure that response behavior was not skewed by the absence of a manager, there was an additional response option of "neither."

Measurement of team task interdependence

Task interdependence is defined as the degree to which team members are dependent on other team members to complete their own tasks (Bishop and Dow Scott, 2000). Task interdependence is measured by four items by Pearce and Gregersen (1991) and translated into German, including "I work closely with others in doing my work" (Appendix 2). Items were answered on a five-point Likert scale, anchored from "fully disagree" (1) to "fully agree" (5).

Measurements of subjectively perceived productivity

To measure productivity on the individual level, the subjectively perceived productivity that participants personally experience was measured. Items were formulated inspired by Hülsheger *et al.* (2006) to assess their productivity according to their task fulfillment. Two more new items were added measuring the quality of the task results and their contribution to team success. An example item is "When you look at your work at your team, how would you rate your productivity?." Items were answered on a five-point Likert scale, anchored from "very low" (1) to "very high" (5) (Appendix 3).

Table 1.
Frequency table local distribution and project management

Project management	Local distribution	
	One site + home office	Multiple sites
Classic	167	31
Hybrid	87	41
Agile	53	32

Measurements of team member satisfaction

The starting point for measuring the satisfaction of the team members was two items of the COPSOQ (Nübling *et al.*, 2005), measuring in particular the satisfaction with team members and the way, the team is managed. These were supplemented by six further items, which record the satisfaction with the cooperation, the support and the accessibility on the one hand with the team colleagues and on the other hand with the manager. Items were answered on a five-point Likert scale, anchored from "very unsatisfied" (1) to "fully satisfied" (5) (Appendix 4).

Results

Measurement model

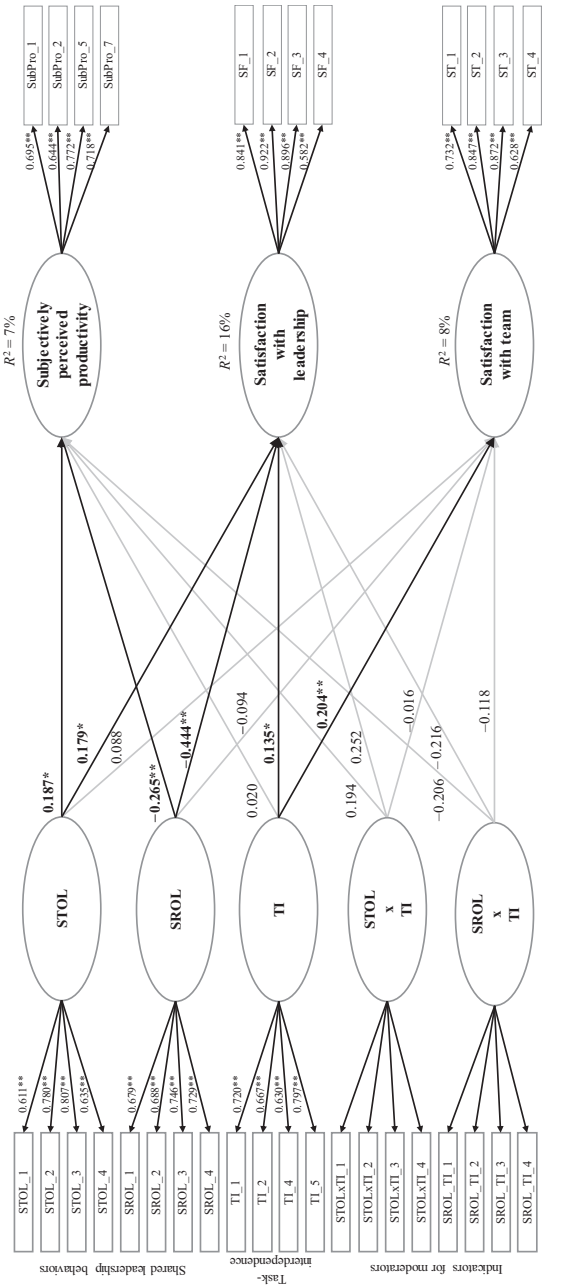
Confirmatory factor analyses were conducted using the software Lavaan to assess and ensure distinctiveness of the factors in the study. The original measurement model did not indicate a good model fit [χ^2 = 1,036.235, df = 512, $p < 0.01$; comparative fit index (CFI) = 0.909; RMSEA = 0.55]; therefore, selected items (see Appendix) were excluded from further analysis because of insufficient or cross-loaded data. In addition, a six-factor model splitting team member satisfaction into two factors, satisfaction with the team and satisfaction with leadership, was found to yield a better model fit than the five-factor model originally adopted. The fitted six-factorial model indicated a better fit to the data (χ^2 = 367.712, df = 237, $p < 0.01$; CFI = 0.963; RMSEA = 0.40) (Table 2), which is supported by the high loading of the items on their respective factors (Figure 2). In addition, Cronbach's α were 0.8 or higher for all measurements (Table 3), and the composite reliability was above 0.7 for all items (Table 4) (Bagozzi and Yi, 2012). The average variance extracted (AVE) is mostly above 0.5, so that a convergent validity of the measurement instruments can be assumed (see Table 4) (Fornell and Larcker, 1981). To test discriminant validity, the square root of each factor's AVE must be greater than the correlations with other latent factors, which is also given (see Table 4) (Fornell and Larcker, 1981). Overall, it can be assumed that the items for recording the latent factors are both consistent and distinct.

Path model

Figure 2 shows the model that was used to test the hypotheses. The model was tested using structural equation modeling with maximum likelihood estimation with robust standard errors and a Satorra–Bentler scaled test statistic using the R-package Lavaan. To test the assumed moderating effect of task interdependence (*H5–H8*), the double-mean-centering strategy according to Lin *et al.* (2010) was used for the analysis. Here, the items of the exogenous variables task- and relations-oriented leadership and the moderator variable task interdependence were first mean centered. Subsequently, product indicators between the items of the moderator variable task interdependence and the items of the constructs task- and relations-oriented leadership were formed

Table 2. Measurement model comparisons

Model	χ^2	df	CFI	RMSEA
Six-factor model	367.712	237	0.936	0.040
Five-factor model	851.752	242	0.824	0.086
One-factor model	2,838.406	252	0.240	0.175



Notes: $*p < 0.05$, two-tailed; $**p < 0.01$, two-tailed; $X^2 = 622.836$, df = 436, CFI = 0.95, RMSEA = 0.037

Figure 2.
Structural equation model with moderation effects

according to the matched pairs strategy (Marsh *et al.*, 2004), which were also mean centered again. The resulting double-mean centered product indicators are considered for the structural equation modeling as indicators for the latent moderation variable.

Because of the oversensitivity of the χ^2−statistics, especially with larger samples, CFI and RMSEA were used to examine model fit (Schermelleh-Engel *et al.*, 2003). The basic idea of the CFI is that the fit of a model of interest is compared to the fit of an independence model. CFI ranges from 0 to 1. An index of 0.97 indicates a good fit relative to the independence model, while values greater than 0.95 may be interpreted as an acceptable fit (Bentler, 1990). The RMSEA is a measure of approximate fit in the population and values are defined as a close fit, when ≤ 0.05 (Steiger, 1990).

The six-factor model, augmented with the interaction terms to test for moderation effects, showed an acceptable fit to the data (CFI = 0.950; RMSEA = 0.037). Figure 2 shows the standardized coefficients for the structural relationships in the model and the variance of the endogenous variables explained by the model.

STOL has a significant positive effect on perceived productivity ($\beta = 0.187$; $p < 0.05$) and satisfaction with leadership ($\beta = 0.179$; $p < 0.05$). The path between STOL and satisfaction with team was not significant. *H1* is supported, and *H2* is supported with respect to satisfaction with leadership but not with the team.

SROL behavior has a significant negative effect on subjective perceived productivity ($\beta = -0.265$; $p < 0.01$) and also a significant negative effect on satisfaction with leadership ($\beta = -0.444$; $p < 0.01$). Therefore, *H3* and *H4* are not supported.

The paths between the outcome variables and the interaction terms STOLxTI and SROLxTI were both nonsignificant, suggesting that task interdependence does not have a significant moderating effect on the relationship between sharing leadership and subjectively perceived productivity and satisfaction. Nevertheless, there is a tendency

Variable	Mean	SD	Cronbach's α
1. Shared task-oriented leadership behavior (STOL)	2.99	0.81	0.80
2. Shared relations-oriented leadership behavior (SROL)	2.90	0.71	0.80
3. Task interdependence (TI)	3.64	0.81	0.80
4. Perceived productivity	4.01	0.53	0.80
5. Satisfaction with leadership	3.83	0.89	0.88
6. Satisfacation with team	4.13	0.68	0.85

Table 3. Mean, standard deviation (SD), and Cronbach's α

			Latent factors					
Latent factors	CR	AVE	1	2	3	4	5	6
1. STOL	0.809	0.522	*0.722*					
2. SROL	0.803	0.505	0.563**	*0.711*				
3. TI	0.797	0.497	0.386**	0.237**	*0.704*			
4. Perceived productivity	0.801	0.503	0.032	−0.167*	0.035	*0.701*		
5. Satisfaction with leadership	0.891	0.678	−0.043	−0.329**	0.096	0.252**	*0.823*	
6. Satisfacation with team	0.859	0.609	0.133*	0.011	0.242**	0.140*	0.462**	*0.780*

Notes: CE = Composite reliability, AVE = average variance extracted, square root of AVE (in italic) and correlation between constructs (off-diagonal). *Correlation is significant at the 0.05 level (two-tailed). **Correlation is significant at the 0.01 level (two-tailed)

Table 4. Results for composite reliability, convergent and discriminant validity

indicating that the relationship between STOL and outcomes might be positively moderated by task interdependence, and the relationship between SBOL and outcomes tends to be negatively moderated by task interdependence. However, because of missing significant results, *H5–H8* were not confirmed.

Discussion

Leadership research examines how leadership can succeed by taking into account the situational circumstances, the persons who are leading and their behavior, so that goals are achieved and employees satisfied. Established leadership models have evolved over time to meet the challenges of the working world. Currently, managers have to cope with new requirements that arise from the increasing virtualization of teamwork. The right leadership behavior is considered central to overcoming local boundaries, building trust and strengthening team cohesion (Malhotra *et al.*, 2007; Morrison-Smith and Ruiz, 2020). With the accompanying complexity, leadership is no longer thought of as merely hierarchical but increasingly as flatly organized.

One suitable approach to leading virtual teams can therefore be the concept of shared leadership, in which leadership responsibilities are distributed among several people in the team, which can make it easier to bridge local distances (Pearce *et al.*, 2004). Previous studies have shown the positive influence of shared leadership on team productivity and other team outcome variables in virtual team settings (Drescher and Garbers, 2016; Hoch and Dulebohn, 2017; Hoch and Kozlowski, 2014; Hoegl and Muethel, 2016; Nordbäck and Espinosa, 2019; Robert and You, 2018).

For a holistic understanding of shared leadership theory, especially for its application in practice, research on shared leadership needs to be extended to a multilevel analysis (Scott-Young *et al.*, 2019). On the one hand, more evidence is needed on the behavioral dimensions of shared leadership; on the other hand, there is limited research on the effects of shared leadership on individual team members (Hill and Bartol, 2016). The results of the present study provide initial empirical data in this regard, especially focusing on individuals, who experience virtual collaboration mostly because team members were locally distributed by working in home offices. Moreover, most participants still work in hierarchical organizational structures and experience shared leadership especially as an emergent team phenomenon, where team members implicitly take over leadership tasks.

For further theoretical contribution and practical implementation, this study investigated for the described sample the extent to which the sharing of task- and relations-oriented leadership behaviors affect the subjectively perceived productivity and satisfaction of team members, to give implications which leadership behaviors can be taken over by other individuals on the team and which should stay with a manager. Because task workflows impact the leadership effect on team outcomes (Parker, 2014), we also examined the extent to which task interdependence moderates these influences.

Surveyed in a questionnaire study and analyzed with structural equation modeling, the results show that shared task- and relations-oriented leadership behaviors among team members have a significant influence on subjectively perceived productivity and satisfaction with leadership. More differentially, the influence of shared task-oriented leadership behaviors was found to be positive and the influence of shared relations-oriented leadership behaviors negative.

Team members in virtual teams thus experience their work as more productive and are more satisfied with the leadership, if the determination of action steps for the execution of tasks, the setting of specific goals, the checking of the progress and the quality, as well as the problem solving are taken over by team members and do not lie solely with the manager. The results go along with the assumptions of participative leadership approaches, which

recommend the situationally appropriate autonomy of employees in the performance of tasks to raise quality of results and satisfaction of employees (Tannenbaum and Schmidt, 2016; Vroom, 2000). Although the results are consistent with the empirical findings on participative leadership, the positive effect contradicts findings from Han *et al.* (2021), which suggest a negative effect of shared task-oriented leadership behaviors on team performance. The contradictory results could be explained by the fact that they studied the effect at the team level, implying that further research on this is needed on possible discrepancies between the team and individual levels and their causes. Furthermore, our study focuses on virtual settings, which places new demands on coordination and in which shared task-oriented leadership behavior could be a solution to address communication and other barriers supported by digital collaboration tools. Finally, cultural differences may account for the contradictory findings. While Han *et al.* (2021) studied the concept in South Korea, which is known as a culture with high power distance and uncertainty avoidance, the present study was conducted in Germany, which is less pronounced in these cultural dimensions, implying that cultural differences should be considered when comparing results of shared leadership studies (Hofstede, 2011).

Contrary to the findings from previous studies (Nordbäck and Espinosa, 2019; Han *et al.*, 2021), the results of the presented study further indicated that it seems to be perceived negatively by team members when team members take on relations-oriented leadership tasks that are expected to lie with the leader. These include providing support and encouragement in stressful situations, praising effective performance, giving helpful feedback and advice and encouraging team members to contribute new ideas to the team. An explanation could be that especially relations-oriented leadership behaviors correspond to the approach of transformational leadership, in which it is envisaged that managers address employees on a deep emotional level and thus motivate them to achieve common goals (Bass and Avolio, 1997). Empirical results show that leaders who manage virtual teams are more effective when they increase their transformational leadership (Purvanova and Bono, 2009). If this is transferred to the present sample of the study, in which shared leadership is recorded as an emergent phenomenon in primarily hierarchical organizational structures, one explanation for the negative correlation could be that team members have the expectation that relations-oriented leadership behaviors will continue to be adopted by the official leader and therefore evaluate it as negatively, when these are taken over by team members. Interestingly, Han *et al.* (2021) also found the opposite effect for relations-oriented behaviors. Here, they postulate a positive relationship mediated through team psychological capital. Participants' personal resources were not considered in our study and should therefore be considered in further studies to clarify the relationship between shared relations-oriented leadership behaviors and outcomes. Moreover, this discrepancy may further point toward possible effects of cultural differences.

Although previous studies provide evidence that task interdependence moderates the relationship between shared leadership and team outcomes (Nicolaides *et al.*, 2014; Wu *et al.*, 2020), this was not confirmed in this study. Analyses show that there is a tendency for task interdependence to strengthen the positive correlations between task-oriented leadership and team outcomes and weaken the negative correlations between relations-oriented leadership behaviors, but it was not confirmed to have a statistically significant moderator effect on the individual level. Future studies should identify further relevant factors and consider them for moderator analyses.

Theoretical implication

By studying the approach of shared leadership in virtual teams in more detail with regard to shared task- and relations-oriented leadership behaviors and their effects on team members,

the study builds on previous findings and examines the concept from an expanded perspective, considering the following two aspects:

(1) operationalization of the concept by capturing which specific leadership behaviors are being shared; and

(2) focusing on the impact on individual team members.

Some theoretical implications to expand the understanding about the shared leadership theory, especially focusing on virtual teams, can be derived from the method and the results of this study. The very first is the extension of research on recent studies on shared leadership behaviors (Sweeney, 2022) because so far shared leadership is mostly operationalized with the help of the social network approach or the aggregation approach (Zhu *et al.*, 2018), which in particular provides information about the leadership structure and the characteristics of the leadership style at team level. Grille and Kauffeld (2015) developed a questionnaire measuring effective shared leadership behavior to rate the extent to which shared leadership was executed by the team on a six-point agreement scale. Since this questionnaire does not capture which specific leadership behaviors are adopted by team members and which lie with the leader, items were developed for this study also based on the behaviors of Yukl's leadership taxonomy, using a bipolar scale to investigate shared leadership as an emergent phenomenon. Because of extended information gain, the operationalization approach of shared leadership on behavioral level should be considered for future studies.

Second, the study extends previous theory on shared leadership by examining the influence of the sharing of leadership behaviors not at the team level but at the individual level. Results show, that not all forms of shared leadership have positive effects on the individual level as it is implied by studies that examine the effects of shared leadership on team outcomes. Therefore, the study results emphasize the importance of more differentiated multi-level research on shared leadership, to give further implications on how shared leadership effects team outcomes and as well outcomes on the individual level (Scott-Young *et al.*, 2019).

Shared leadership is defined as an emergent team phenomenon (D'Innocenzo *et al.*, 2016). In practice, this often means that team members take on leadership tasks in existing hierarchical organizational structures because of circumstances such as locally distributed collaboration (Mayer, 2021). The study addresses how the shared leadership approach can succeed in meeting the challenges of virtual collaboration. Results show that STOL behaviors have a significant positive impact, but relations-oriented leadership behaviors have a significant negative effect and therefore should not be shared among team members and might better be executed by a transformational leading manager. The findings support the assumption that a more comprehensive leadership model is needed that considers and combines different leadership approaches for leading virtual teams (Eisenberg *et al.*, 2019; Sweeney, 2022). For this reason, a theoretical framework should be developed that takes into account that the concept of shared leadership is not an alternative model to hierarchical leadership but can be a relevant concept as a solution approach next to hierarchical leadership to successfully lead virtual teams with respect to task- and relations-oriented leadership challenges.

Practical implications

With the current increase of virtual collaboration within teams, leadership is considered central to overcoming accompanying challenges (Kozlowski *et al.*, 2021). Based on empirical findings, shared leadership is considered as one solution approach for leading virtual teams (Hoch and Kozlowski, 2014). The present study builds on previous findings and, with its study design, aims to provide clearer implications as to which specific leadership behaviors can be distributed to team members. In context of mostly still existing hierarchical organizational structures in virtual team settings,

study results show that the sharing of task-oriented leadership behaviors among team members should be proactively enabled, while relations-oriented leadership behaviors should continue to be adopted by the official leader. The results thus emphasize the relevance of looking closely at which leadership behaviors can be decentralized and when it is still important that certain leadership tasks are taken over by one person. In addition, for practical implementation, consideration should be given to how shared leadership behavior and also transformational leadership can be promoted within team structures both at the behavioral level and at the structural level, in particular whether the concept of shared leadership is structurally anchored in the organization, and thus, team members experience recognition and rewards for taking on leadership tasks.

Limitations and future directions

For this study there are some limitations that should be considered. The data were collected in 2021, when because of the pandemic working in home offices had been recommended and implemented in Germany for a year. Thus, distributed collaboration was already well integrated into the work organization, but the specific conditions should still be considered when interpreting the results on subjectively perceived performance and satisfaction with leadership.

The study was conducted as an online survey, i.e. participants filled in the questionnaire based on their individual experiences of being in their workplace. This provided the desired insights into the impact of shared leadership at the individual level, but since the participants were not from the same organization, it was difficult to systematically account for disruptive factors because of the work environment. Future studies on the impact of shared leadership at the individual level could select a sample where participants are from the same work context to exclude associated disruptive factors. In general, self-ratings of variables such as performance must always be interpreted with caution. Nevertheless, we chose to use self-ratings variables in this study to gain insight into individual experiences with shared leadership. This could also be a reason for conflicting results with previous studies on behavioral dimensions, such as Han *et al.*, 2021. Future studies looking at employees' experiences with shared leadership should be expanded, for example, by measuring performance with additional objective sources. This in turn implies that a multilevel approach should be considered when examining shared leadership behaviors to supplement research on the effects of shared leadership behaviors on team outcomes.

Further, new items were formulated to measure the extent to which task- and relations-oriented leadership behaviors are taken over by leaders or team members. Although based on analyses the used items were found to be consistent and distinct, they need further validation when using for measuring shared leadership.

With focus on moderating effects and context factors, in this study only task interdependence was considered as a moderator variable, which did not show any significant effects. For more detailed practical implications on the possibilities of sharing leadership behaviors within a team, other factors such as existing leadership and team structures or project management styles should be considered in future analyses to give clearer implications about the circumstances.

Overall, the study provides only initial indications of which leadership behaviors can be shared and which cannot. Therefore, much more research is needed to give substantiated empirical advice for implementing shared leadership in context of virtual teams. From this study, further research questions arise like if shared leadership should be combined with other leadership approaches or if it should be explicitly integrated into team and leadership structures to have positive effects on team members and team outcomes.

Conclusion

To conclude, the present study explicitly addresses which leadership behaviors can be shared in virtual teams and how it affects individual team members. Mainly shared leadership behaviors were measured that emerged from the team, because the majority of participants worked in a hierarchical organizational structure. The hypotheses stating that shared task-oriented leadership behaviors have a significant positive effect on subjectively perceived productivity and satisfaction with leadership were confirmed for the virtual team context. The postulated positive effect of shared relations-oriented leadership behaviors on the output variables was not confirmed. Instead, the results show that in virtual teams SROL behaviors have a significant negative effect on subjectively perceived productivity and satisfaction with leadership. Hypothesis on the moderating effect of task interdependence were not confirmed. For future research, a theoretical framework for leading virtual teams should be developed further and empirically examined considering combinations of the shared leadership concept with hierarchical leadership concepts to address all challenges of leading virtual teams.

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Appendix 1

Items used to measure sharing task-oriented leadership behaviors:

- *Plan and coordinate tasks.*
- Determine action steps for the execution of tasks (STOL_1).
- *Explain tasks and related responsibilities.*
- Set specific goals and deadlines for the completion of tasks (STOL_2).
- Check the progress and quality of the processing of tasks (STOL_3).
- *Obtain information to check the progress of the work.*
- *Identify confounding factors that may be encountered while completing tasks.*
- Take action to resolve problems encountered in the processing of tasks (STOL_4).

Items used to measure sharing relations-oriented leadership behaviors:

- Provide support and encouragement for upcoming difficult or stressful tasks (SROL_1).
- *Show interest in the needs and feelings of individual team members.*
- Praise effective performance (SROL_2).
- *Suggest appropriate rewards for high performance by one person on the team.*
- Give helpful feedback and advice (SROL_3).
- *Encourage personal growth.*
- Encourage team members to contribute their suggestions and opinions to the team (SROL_4).
- *Involve team members in decision-making processes.*

Note: Italic formatted items were not considered for analysis

Appendix 2

Items used to measure task interdependence:

- I work closely with others in doing my work (TI_1).
- I frequently must coordinate my efforts with others (TI_2).
- *My own performance is dependent on receiving accurate information from others.*
- The way I perform my job has a significant impact on others (TI_4).
- My work requires me to consult with others fairly frequently (TI_5).

Note: Italic formatted items were not considered for analysis

Appendix 3

Items used to measure subjectively perceived productivity:

When you look at your work in the team. . .

- . . . how do you value your productivity? (SubPro_1)
- . . . *how do you value your productivity compared to a person performing a similar job?*
- . . . how do you value the success with regard to the fulfillment of your tasks? (SubPro_5)
- . . . how do you value the quality of your work results? (SubPro_2)
- . . . how do you value your contribution to team success? (SubPro_7)
- . . . *how do you value your contribution to the quality of teamwork?*

Note: Italic formatted items were not considered for analysis

Appendix 4

Items used to measure team member satisfaction:

When you look at your work situation in your team. . .

- . . . how satisfied are you with the team colleagues you work with? (ST_1)
- . . . satisfied are you with the cooperation in the team? (ST_2)
- . . . how satisfied are you with the support you receive from your team colleagues? (ST_3)
- . . . how satisfied are you with the accessibility of your team colleagues? (ST_4)
- . . . how satisfied are you with the way your team is managed? (SF_1)
- . . . how satisfied are you with the cooperation with your manager? (SF_2)
- . . . how satisfied are you with the support you receive from your manager? (SF_3)
- . . . how satisfied are you with the accessibility of your manager? (SF_4)

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