

Small Group Research

<http://sgr.sagepub.com>

Effects of Process Feedback on Motivation, Satisfaction, and Performance in Virtual Teams

Susanne Geister, Udo Konradt and Guido Hertel

Small Group Research 2006; 37; 459

DOI: 10.1177/1046496406292337

The online version of this article can be found at:
<http://sgr.sagepub.com/cgi/content/abstract/37/5/459>

Published by:

 SAGE Publications

<http://www.sagepublications.com>

Additional services and information for *Small Group Research* can be found at:

Email Alerts: <http://sgr.sagepub.com/cgi/alerts>

Subscriptions: <http://sgr.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

Citations (this article cites 44 articles hosted on the SAGE Journals Online and HighWire Press platforms):

<http://sgr.sagepub.com/cgi/content/refs/37/5/459>

Effects of Process Feedback on Motivation, Satisfaction, and Performance in Virtual Teams

Susanne Geister

Udo Konradt

University of Kiel

Guido Hertel

University of Wuerzburg

In virtual teams, the lack of feedback and information about team processes is a major problem. To encounter this challenge of virtual teamwork, team process feedback was provided by an Online-Feedback-System (OFS). It contained feedback regarding motivation, task-related aspects, and relationship-related aspects. A longitudinal study of 52 virtual teams with student participants was conducted. Teams that used the OFS showed an increase in performance compared with controls that did not use the OFS. Furthermore, results indicate initial motivation as a moderating variable on the improvement caused by the OFS. Positive OFS effects were found on motivation and satisfaction for the less motivated team members. Furthermore, for less motivated team members, effects of the OFS on performance were mediated by interpersonal trust. Overall, results imply that team process feedback has a positive effect on motivation, satisfaction, and performance in virtual teams.

Keywords: *process feedback; virtual teams; motivation; trust; team building*

Theoretical Background

Virtual Teams

The spreading implementation of new information and communication technology has led to many changes in organizations (e.g., cooperative work independent of time and space, which enables virtual teamwork). Virtual teams are defined as two or more persons who work together on a mutual goal or work assignment, interact from different locations, and therefore

communicate and cooperate by means of information and communication technology (Bell & Kozlowski, 2002; Hertel, Geister, & Konradt, 2005; Konradt & Hertel, 2002). Virtual teams offer several strategic advantages for organizations and employees, for example, connecting competent employees for a project regardless of their location, providing greater flexibility to individuals, and saving expenses for traveling and office equipment.

However, virtual teams also face several challenges because of the dislocation and reduction of social contact among team members. In comparison to traditional face-to-face teams, virtual teams often show lower performance levels in terms of group decision effectiveness and the time needed to reach decisions (Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002; Hollingshead & McGrath, 1995). However, these differences seem to attenuate over time (Bordia, 1997; Hollingshead & McGrath, 1995). Virtual teams also show lower levels of other outcome variables, such as group cohesion and work satisfaction (Baltes et al., 2002; Warkentin, Sayeed, & Hightower, 1997), and challenges arise regarding process variables, such as motivation (Hertel, Konradt, & Orlikowski, 2004) and trust (Jarvenpaa & Leidner, 1999). Because motivation is a crucial process variable in virtual teams, the focus of this research will be on motivational processes within virtual teams.

Motivation in Virtual Teams

Many theories refer to motivational processes in individuals, such as the direction, effort, and persistence of individual effort (for reviews, see Ambrose & Kulik, 1999; Eccles & Wigfield, 2002). However, motivational processes are crucial not only for individuals but also for the performance of teams. The collective effort model (CEM) is an Expectancy \times Value model of motivation in groups that specifies several components that determine the individual motivation of persons working in a team (e.g., Karau & Williams, 1993, 2001). The VIST model (Hertel, 2002) is a model of motivational processes in virtual teams based on the CEM and cooperation research that use game-theoretical paradigms ("social dilemmas"; e.g., Foddy, Smithson, Schneider, & Hogg, 1999). Its name is an acronym of its four components that are supposed to be essential for the individual motivation of virtual team members: valence, instrumentality, self-efficacy, and trust.

Authors' Note: The data of this study were part of the PhD thesis of the first author who was part of the graduate school "Loosely Coupled Systems" funded by the German Research Foundation. Correspondence concerning this article should be addressed to Dr. Udo Konradt, University of Kiel, Department of Psychology, Olshausenstr. 40, 24 098 Kiel, Germany; phone: (+49) 431-8803676; fax: (+49) 431-8801559; e-mail: konradt@psychologie.uni-kiel.de.

Valence is defined as the subjective importance of team goals for team members. Lipnack and Stamps (1997) summarized anecdotal reports of work experience wherein an early demotivation of virtual team members is often caused by a deficient communication of team goals. This might lead to an insufficient weighting of and identification with team goals. For that reason, a clear definition of team goals and transparency in goal setting are necessary for virtual team success.

Instrumentality is defined as the perceived indispensability of individual contributions. Results of various experimental studies (Hertel, Deter, & Konradt, 2003; Hertel, Kerr, Scheffler, Geister, & Messé, 2000; Kerr & Bruun, 1983) and a field study with virtual teams (Hertel et al., 2004) show that higher levels of indispensability of individual contributions can correspond to higher levels of motivation and performance. Indispensability of personal efforts for the team outcome can be increased by framing the task assignment clearly and transparently, giving feedback for achieving goals, and communicating relationships between tasks and team member contributions.

Self-efficacy is defined as the perceived capability to fulfill the tasks required in a team. This concept is based on the social-cognitive theory by Bandura (1986). Staples, Hulland, and Higgins (1999) demonstrated in a field experiment with telecommuters that perceived self-efficacy correlated with performance, work satisfaction, and stress management. Self-efficacy can be strengthened by feedback on positive results and training regarding the conditions of virtual teamwork.

“Trust is seen as a willingness to rely or depend on some event, process, individual, group or system in whom one has confidence or faith” (Clark & Payne, 1997, p. 208). Specifically, the VIST model refers to the perceived trust both in other team members (interpersonal trust) and in the electronic support system (e.g., reliability of the information and communication technology). A number of experimental studies have shown that electronic communication leads to decreased trust and less cooperative behavior in teams (Bos, Olson, Gergle, Olson, & Wright, 2002; Jensen, Farnham, Drucker, & Kollock, 2000). Furthermore, in virtual teams, trust has been identified as an important precursor for successful virtual teamwork (Jarvenpaa & Leidner, 1999). Enabling face-to-face meetings (e.g., kick-off events) and encouraging informal communication between group members and a constructive conflict management seem to enhance virtual team trust.

Collaboration across great distances leads to increased demands not only for the members but also for the leaders of virtual teams. Because strategies

of face-to-face influence and direct guidance of team members are restricted, team leaders need to employ more indirect and structural forms of leadership (Duarte & Snyder, 2001). A leadership concept that has been proposed as appropriate for remote work situations is management by objectives (MBO; Hertel et al., 2004; Konradt, Hertel, & Schmook, 2003). MBO builds on the goal-setting theory (Locke & Latham, 1990) and places an emphasis on three components: goal setting, participation of employees in planning and decision making, and feedback during task fulfillment (Odiorne, 1986). One difficulty in reaching a high quality of goal setting procedures in virtual teams is that leaders and members rely on media with low degrees of richness (Daft & Lengel, 1986) or capacity to process ambiguous communication in organizations. Therefore, it is important to exchange perceptions about the goal-setting process as directly as possible to allow quick reactions and adjustment.

To summarize, virtual collaboration leads to challenges regarding team members' motivation, relationship building, and the leadership of a team. Because virtual team members rarely meet personally, it is difficult for them to engage in a regular exchange of feedback and information. Increasing feedback could lead to positive effects on motivation, satisfaction, and performance of teams. Before we have a closer look at feedback in virtual teams, we will discuss feedback in general by focusing on different feedback forms and the mechanisms of how feedback affects performance.

Feedback

Feedback typically consists of information provided to an individual for the purpose of an increase in performance (Earley, Northcraft, Lee, & Lituchy, 1990; Kluger & DeNisi, 1996). A variety of feedback forms exists, which are described by different aspects (Balcazar, Hopkins, & Suarez, 1986). One aspect is the type of feedback, with outcome feedback (i.e., information concerning performance outcomes) on the one hand and process feedback (i.e., information concerning how one performs a job) on the other. A second aspect pertains to the feedback recipients. Feedback can be received by individuals or by teams (individuals working in a team context). Team feedback can be given at different levels: on an individual level or on a team level (i.e., individual feedback aggregated on a team level and presented to the whole team). A third aspect is the feedback source. Feedback can be given by subordinates (bottom-up), by supervisors (top-down), by peers or colleagues (horizontal), or by combining these sources (multisource feedback). A fourth aspect is the purpose of the feedback

intervention. Feedback can be used either for evaluative or developmental reasons.

It is important to distinguish between different feedback forms because of the underlying assumptions regarding the mechanisms of how feedback leads to performance increases. Next, we will describe main results and mechanisms of how feedback affects individuals and teams.

Outcome feedback increases performance not only for individuals (Kluger & DeNisi, 1996) but also for teams (Burgio, Engel, Hawkins, McCormick, & Scheve, 1990; Goltz, Citera, Jensen, Favero, & Komaki, 1989), especially if it is combined with goal setting (Mento, Steel, & Karren, 1987; Neubert, 1998; Tubbs, 1986). Concerning different aggregation levels of team feedback, it was demonstrated that the performance increase attained by team-level team feedback was not as high as the performance increase obtained by individual-level team feedback (Burgio et al., 1990; Goltz et al., 1989). The underlying mechanism for the effects of outcome feedback is an increase in effort, which in turn leads to an increase in performance (Kluger & DeNisi, 1996; Locke & Latham, 1990).

Process feedback is less studied compared with the vast literature on outcome feedback (Earley et al., 1990; McLeod & Liker, 1992). In their literature review, Korsgaard and Diddams (1996) conclude that "supplementing outcome feedback with more explanatory types of feedback is superior to outcome feedback alone in producing performance improvements" (p. 1890). Although individual process feedback usually includes task-related information, process feedback in a team context might contain not only information about behaviors, actions, or strategies regarding the task (task related) but also information about interpersonal behaviors and the teamwork (relationship related) and about the motivation of team members (i.e., motivational feedback).

In an instructive study by McLeod and Liker (1992), team process feedback included interpersonal behaviors of student team members, such as dominance and group orientedness that were rated by external observers. This feedback changed the dominance behavior of individual team members. Two other studies with student teams investigated peer feedback regarding behaviors of each member (e.g., communication and collaboration) that led to an increase in motivation, communication, cooperation, and satisfaction of team members (Dominick, Reilly, & McGourty, 1997; Druskat & Wolff, 1999). Specifically, these studies investigated individual level team feedback (i.e., individualized feedback about the behaviors of team members). To our knowledge, no previous study has investigated team-level team process feedback.

Team process feedback is thought to increase task solving by improving interpersonal processes (Dominick et al., 1997). Team process feedback might focus team members' attention to process variables, such as motivation, communication, and cooperation, triggering improvements regarding these processes. According to models of work group effectiveness, the interpersonal process is a crucial antecedent of team performance (Hackman, 1987; McGrath, 1991). McLeod and Liker (1992) investigated interpersonal processes and performance and found an effect of feedback on interpersonal processes but not on performance. Although Druskat and Wolff (1999) and Dominick et al. (1997) showed that team process feedback promoted interpersonal processes, they did not directly look at the performance of teams. Thus, empirical support of whether or not team process feedback leads to enhanced interpersonal processes, which in turn increases team performance is still lacking.

Feedback in Virtual Teams

There is support for a relationship between feedback and performance in virtual teams. Duarte and Snyder (2001) proposed the importance of outcome feedback from team leader to team members for team performance. Jarvenpaa and Leidner (1999) asserted that thorough feedback among team members is essential for developing and maintaining trust and high performance. Dennis and Valacich (1999) regard feedback as important for reaching a common understanding and mutual agreement among team members, which helps the notion of common ground develop (Olson & Olson, 2001). In sum, there is support for a beneficial effect of feedback on virtual teamwork, but empirical studies are still lacking. Furthermore, it is unclear which form of feedback is most influential.

We believe that virtual teams will mostly benefit from team process feedback. Unlike face-to-face teams, they cannot look around and see if their team members are working, what they are doing, and how they like it (Kraut, Fussell, Brennan, & Siegel, 2002). According to the media richness theory (Daft & Lengel, 1986; Dennis & Valacich, 1999), electronic media are characterized as being lean media that only allow delayed and limited feedback during the work process. Because electronic communication shows more task-related and fewer team-related contents than does face-to-face communication (Chidambaram, 1996; Kraut, Galegher, & Egido, 1987), virtual team members are often insecure about whether their team partners are motivated and/or satisfied with their collaboration. Indeed, in an exploratory

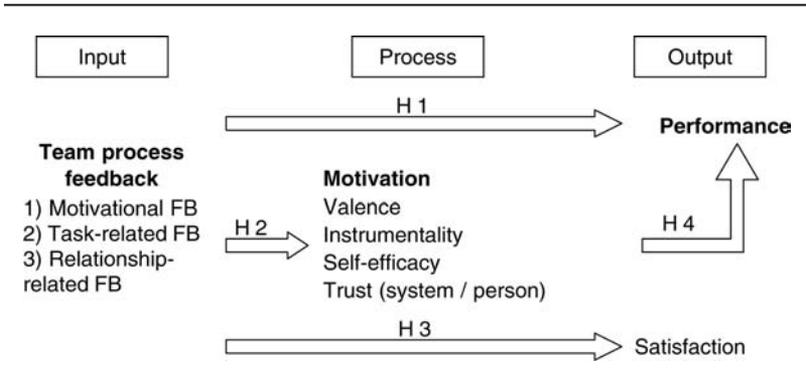
study, team process feedback about motivation and emotions of the other team members led to an increase of team well-being and a higher participation (Zumbach, Muehlenbrock, Jansen, Reimann, & Hoppe, 2002).

However, in the literature on computer-supported cooperative work, feedback itself is rarely mentioned; instead, awareness as a related concept is widely studied. Awareness is defined as the "understanding of the activities of others, which provides a context for your own activity" (Dourish & Bellotti, 1992, p. 107). It is associated with positive effects on collaboration, such as coordinating activities, simplifying verbal communication, providing appropriate assistance, and managing shared work (Gutwin & Greenberg, 1999). Weisband (2002) showed a positive relation between team awareness and team performance in a study with virtual student teams working together during the course of four weeks. Jang, Steinfield, and Pfaff (2002) have developed a Web-based collaborative tool that was designed to support team awareness. Results of their study of eight student teams working on a design project for four months imply that a higher team awareness about activities and perspectives of other team members leads to more communication and a higher satisfaction of members in a virtual team.

Furthermore, we propose a link between feedback and awareness. Specifically, we argue that among the different feedback forms, team process feedback shows the largest overlap to the concept of awareness. For instance, both concepts focus on teams similarly, providing information about activities and perceptions of team members rather than about the performance of team members. Another similarity is that both are often operationalized in the form of peer feedback (i.e., group peers give and receive feedback). However, awareness and feedback concepts are also different in some aspects. Team process feedback is increased by providing behavioral observation scales (Dominick et al., 1997) or structured team assignments (Druskat & Wolff, 1999). In contrast, when maintaining awareness, team members are asked to gather information from their workspace environment (Gutwin & Greenberg, 1999). In this case, team members have to infer awareness information from e-mail communication (Weisband, 2002) or from the activities of others (e.g., uploads and downloads of documents done by members; Jang et al., 2002). As a result, an awareness distribution is much more subtle, subjective, and less controllable than a feedback distribution.

To summarize, we assume team process feedback to be a core element of awareness, with awareness being a much broader concept that includes

Figure 1
Research Model



a wider range of information exchange. If this is true, team process feedback should increase awareness, and results from awareness studies may in part be transferred to feedback interventions. Because the distribution of team process feedback is more structured and manageable, it might be an easier way to increase awareness. Both forms aim at enhancing the processes and outcomes of (virtual) teams.

Summary and Hypotheses

We adapted our research model from an input-process-output model for teamwork (Hackman, 1987; see Figure 1). Team process feedback is considered an input factor, whereas motivation is considered a process variable. Moreover, because team success is measured not only by performance indicators but also by subjective well-being (Hackman, 1987; McGrath, 1991), outcome variables are team performance and team members' satisfaction with the team.

There is substantial empirical support for the positive influence of outcome feedback on the performance of individuals and conventional teams (Kluger & DeNisi, 1996; Mento et al., 1987; Tubbs, 1986). Studies on team process feedback assume that process feedback supports communication and collaboration in face-to-face teams (Dominick et al., 1997; Druskat & Wolff,

1999). Improved team processes, in turn, are thought to increase team outcomes (Hackman, 1987; McGrath, 1991), although no increase in performance by team process feedback was empirically shown. For virtual teams, an increase in awareness was already shown to increase the performance of virtual teams (Weisband, 2002). Combining these two streams of research, not only outcome feedback for conventional teams but also team process feedback for virtual teams, might lead to an increase in team performance.

Hypothesis 1: Team process feedback increases virtual team performance.

Although there is little empirical research on team process feedback, a few studies show a positive influence of feedback on team member motivation in face-to-face teams (Druskat & Wolff, 1999) and virtual teams (Zumbach et al., 2002). It seems that, on the whole, virtual teams predominantly communicate about task-related aspects (Chidambaram, 1996; Kraut et al., 1987). As a consequence, uncertainty exists about team members' motivation and efforts exerted to reach team goals. Through this form of task-related communication, team members are forced to imply team members' motivation by their activities or little hints in e-mails (i.e., one aspect of team-related awareness). Not knowing if team members are motivated raises the risk of personal exploitation (Kerr, 1983). By being provided with the specific and concrete feedback about the motivation of team members, one's own efforts can be adjusted and exerted without the fear of exploitation. Furthermore, providing motivational feedback might focus the attention of team members on motivation and trigger reflection and improvements of motivational indicators. Thus, we propose that team process feedback leads to an increase in motivation.

Hypothesis 2: Team process feedback increases the motivation of team members in virtual teams.

Virtual teams, as teams in general, face not only task-related challenges but also team-related needs. Accordingly, team success includes performance and satisfaction measures (Hackman, 1987; McGrath, 1991). In his time, interaction and performance theory, McGrath (1991) suggested that teams have to engage in relationship-building activities to build up the group well-being function. However, research shows that it is easier to establish and nurture relationships in a face-to-face context than in a virtual context (Warkentin et al., 1997). This may in part be explained by the media richness theory,

which predicts that the lack of contextual cues and timeliness of feedback inherent in computer-mediated communication will negatively affect the development of relationships (Daft & Lengel, 1986). Furthermore, it was found that virtual teams show more task-related than socioemotional and team-related communication (Bordia, 1997; Chidambaram, 1996).

For this reason, we assume that team-related communication supports relationship building and leads to an increase in team satisfaction. Indeed, Druskat and Wolff (1999) demonstrated that team process feedback results in enhanced team satisfaction. Team process feedback might serve as a relationship-building activity because team members can express themselves, get to know to each other, receive a clearer picture of the team situation, and get a chance to react immediately to changes in the teamwork. These activities are viewed as supporting the group's well-being function and are assumed to result in an increase in team satisfaction (McGrath, 1991).

Hypothesis 3: Team process feedback leads to an increase in team members' satisfaction with the virtual team.

The fourth hypothesis regards the mechanisms of how feedback leads to performance increases. Team process feedback is thought to support task solving by improving interpersonal processes (Dominick et al., 1997; McLeod & Liker, 1992), which in turn enhance team performance (Hackman, 1987; McGrath, 1991). We assume that the effects of team process feedback on performance are mediated by motivational variables.

In this study, the VIST model will be used to explore motivational effects in more detail. More precisely, team process feedback might enhance the valence of team goals because regular information about the team situation might increase the salience of teamwork simply by focusing attention on the collaboration. Team process feedback also might support the self-efficacy of team members because members are able to acknowledge good performances and communicate satisfaction with their teamwork. Finally, team process feedback might also enhance interpersonal trust because it supports a sense of knowing each other and feeling informed about the perceptions and activities of team members. Thus, team process feedback might focus team members' attention on motivational processes, which would lead to an increase in their motivation. This, in turn, might lead to a higher performance of the team.

Hypothesis 4: The performance enhancing effect of team process feedback is mediated by motivational variables.

Method

Participants

A total of 104 students from eight German universities participated in the study. Students were randomly assigned to teams of two members, forming 52 teams. Teams were composed of same-gender team members from different cities so that team members would not know each other. Students were 24.1 years old on average ($SD = 2.7$) and were in their 3rd year of studying psychology (57.5%), business administration (32.1%), or other subjects (10.4%). Two thirds of the participants were female, and one third were male. At the conclusion of the project, team members certified that they had communicated exclusively by electronic communication tools (e.g., e-mail, phone) and had not had face-to-face contact. Motivation for participation was ensured by embedding the project in student courses and giving course credit for their participation. The course grades of about half of the participants (i.e., approximately one team member per team) depended on their performance in the project. Furthermore, a reward of about 50 euro for every 10th team was offered, which was determined by a lottery.

Procedure

The introduction of the study explained that each team was supposed to be a consulting company. Before the teams started, they were asked to exchange basic personal information, to name their consulting company, and to play an icebreaker game to build up a basis for mutual teamwork (see Wohlberg, Gilmore, & Wolff, 1995, pp. 34-35, for details of the instruction).

Task. Teams had to develop two problem solutions for two separate clients of their consulting company. Problems were illustrated in case studies (Wohlberg et al., 1995). The first case study (“square pegs”) pictured a travel agency with four staff members. The head of the travel agency was worried because the motivation and satisfaction of the coworkers decreased during the course of the past months. Students were asked to develop solutions for reorganizing work tasks and enhancing the motivation and satisfaction of the staff. The second case study illustrated two different kinds of leadership styles (“two supervisors—a study in style”). Students were asked to develop a solution for merging two departments that represented the two leadership styles. Teams had three weeks for developing the solution proposals for each case.

Manipulation of feedback. An Online-Feedback-System (OFS) was developed to manipulate weekly feedback. Teams were randomly assigned to the OFS condition (26 teams) or the non-OFS condition (26 teams). The OFS was used for five weeks in total. Each week an e-mail was sent to remind team members to complete the OFS.

Data collection. To obtain data, a Web-based survey was administered at two times: Time 1 was at the beginning of the project (before using the OFS), and Time 2 was at the end of the project (after using the OFS for five weeks). The return rate dropped from 95% to 87% during the course of the study. Data used to estimate the overall effect of feedback pertain to the survey, which included the following measures.

Dependent Variables

Motivation. Motivational variables were based on the VIST model (Hertel, 2002) and were measured with five separate scales adapted from Hertel et al. (2004). The valence scale included four items (e.g., "It is important to me that my team reaches its goals"). The instrumentality scale was also composed of four items (e.g., "I believe that my contribution to the team's success is very important"). The self-efficacy scale was developed according to the concepts of Bandura (1986) and included four items (e.g., "I feel capable of accomplishing my tasks in this team"). Interpersonal trust was measured with nine items addressing trust in work-related attitudes and competencies of other team members (e.g., "I can trust that I will have no additional demand due to lack of competence of other members of my team"). This scale was built on a trust scale developed by McAllister (1995). Trust in the technological equipment and support was measured with three items (e.g., "I can trust that the technical equipment of my virtual team always works"). Item formulations were adapted from a scale of Buessing and Broome (1999). All items were answered on a 5-point, Likert-type scale with values ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Separate principal components analyses with Varimax rotation of the VIST items at both measurement points confirmed the assumed five factor structure, explaining 64.0% of variance at Time 1 and 67.7% at Time 2. Almost all items showed factor loadings above .50 on the expected factor at both measurement points. However, two items of the instrumentality scale and two items of the self-efficacy scale had to be excluded because of

multifactorial loadings. Three scales showed satisfying reliability: valence ($\alpha_1 = .76$, $\alpha_2 = .79$),¹ trust in the system ($\alpha_1 = .66$, $\alpha_2 = .69$), and interpersonal trust ($\alpha_1 = .87$, $\alpha_2 = .93$). Reliability for self-efficacy ($r_1 = .46$, $r_2 = .61$) and instrumentality ($r_1 = .38$, $r_2 = .30$) was lower, which might be because of the small number of items in these scales ($n = 2$).

Performance. Performance was measured with subjective ratings and expert ratings. Team members rated their perceived team effectiveness regarding the (a) overall percentage of goal accomplishments, (b) the quality of teamwork, (c) the quantity of the team results, (d) the initiative and motivation of the team, and (e) the adherence to deadlines. The items were answered on a scale ranging from 0% to 100%. Reliability was highly acceptable ($\alpha_1 = .84$, $\alpha_2 = .81$).

In addition to subjective performance ratings, expert ratings regarding the performance of student teams were collected. Two trained experts, blind to the experimental conditions, rated the two written proposals of the student teams independently from each other. Two ratings were collected: (a) form, including appearance and structure of the solution proposal, and (b) content, regarding quality and practicability of the solution proposal. Experts ratings were collected on a 5-point scale from 1 (*insufficient*) to 5 (*very good*). Reliability analyses supported an aggregation of the ratings over experts. Intraclass correlation coefficient (ICC) scores (Shrout & Fleiss, 1979) indicated satisfying reliability (for form ICC = .79 and ICC = .72, and for content ICC = .60 and ICC = .55 for Time 1 and Time 2, respectively).

Satisfaction. Satisfaction was used to measure affective team well-being (McGrath, 1991). The scale contained three items (e.g., "I am satisfied with the climate in my team") and six items to measure cohesion based on a scale developed by Riordan and Weatherly (1999). Items were answered on a 5-point, Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Reliability was $\alpha_1 = .89_1$ and $\alpha_2 = .95$, respectively.

Demographic measures. Demographic measures (e.g., age and gender) were included in the survey as well.

Manipulation check. OFS users were asked to rate their satisfaction with the OFS regarding the user-friendliness and the comprehensibility of handling and contents of the OFS (e.g., "The OFS is user-friendly"). Furthermore,

open questions for positive aspects and suggestions for improvement were included. Items were answered on a 5-point, Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Manipulation of Feedback Development of the OFS

Because virtual teams mainly communicate via the World Wide Web, an OFS was developed and set up on the Internet. Computerized feedback was shown to allow a more task-oriented handling of negative feedback (Kluger & DeNisi, 1996). Peers (i.e., team members) acted both as feedback sources and receivers. Because we aimed at enhancing communication among team members about team processes, we chose subjective perceptions of team members instead of objective (external) information as the source for the process feedback. Subjective peer feedback might have been inaccurate from time to time, and because we had two members in each team, anonymity was not guaranteed, but we wanted to stimulate communication among team members about their subjective perceptions of the collaboration to improve their teamwork. Team members received feedback on a team level because a minimal complexity of team level feedback lowers the time needed for reading and understanding the feedback (Goltz et al., 1989). We decided to provide developmental feedback because it has been shown to be more accepted, less lenient, less subject to halo error, and more reliable than evaluative feedback (Farh, Cannella, & Bedeian, 1991).

Team members were asked to rate 14 items of the three feedback content dimensions once a week during a period of five weeks. Motivational feedback included five items regarding the five components of the VIST model. An example item for valence was, "In the last week the team goals were very important for me." Task-related feedback included three items regarding the main components of MBO (e.g., "In the last week I participated in the planning and distribution of tasks."). Relationship-related feedback included six items regarding satisfaction, team identity, and conflict management. One of these items was, "In the last week I was satisfied with the cooperation and communication in my team."

Team members' feedback ratings were collected on a 7-point scale ranging from *strongly disagree* to *strongly agree*. All items were worded in the same direction: Agreements were equivalent to positive evaluations and were colored green, indicating a positive state. On the opposite end, disagreements indicated a negative evaluation of team aspects and therefore were colored red, indicating a negative state. These colored scales were used for collecting the ratings and for feedback. Feedback about the 14 items was

given to each member on an accumulated team level. It was available for the preceding week and the weeks before. Only the central tendency of team members' ratings (mean) and no indices of the distribution (range, variance) were shown. The colored scales and the simple feedback supported a plain feedback. Thus, team members could detect, in a simple way, which team aspects were rated as satisfying and which aspects were rated as improvable. In addition, guidelines for improving virtual teamwork were included in the OFS. However, ratings within the OFS were not used for data analyses. Results pertain to the data that were collected with the evaluation survey.

Results

Preliminary Analyses

The main data analyses were conducted at the team level. To ensure the appropriateness of aggregating the subjective variables measured at the individual level to the team level (Kenny, Kashy, & Bolger, 1998), each scale was assessed using the $r_{wg(L)}$ as an index of team agreement (Lindell, Brandt, & Whitney, 1999). The ICC was not calculated because, in homogeneous samples, as in this study, the between-group variance might be smaller than the within-group variance, even if the latter is small in absolute terms (Kenny, Mannetti, Pierro, Livi, & Kashy, 2002). Team agreement was averaged for both measurement points. Except for valence, $r_{wg(L)} = .53$, all other variables show a satisfying interrater agreement, ranging from $r_{wg(L)} = .65$ for interpersonal trust to $r_{wg(L)} = .80$ for self-efficacy, thus confirming the appropriateness of aggregation. Subsequent analyses were performed using each team's average score for the subjective variables.

To address the issue of common method variance in the subjective variables (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), Harman's one-factor test was conducted. All seven scales were included in an exploratory factor analysis. Two factors that explain 47.65% and 18.99% of variance at Time 2 resulted. Although this result does not completely rule out that common method variance is a problem, it indicates that more than one factor accounts for the covariances among the items (Podsakoff et al., 2003).

Means, standard deviations, and correlations of the variables on team level are shown in Table 1. Subjective performance ratings correlate positively with the expert ratings regarding the content of the solution proposal ($r = .37, p < .01$), suggesting that the subjective performance ratings are

Table 1
Means, Standard Deviations, Reliabilities, and Intercorrelations of Study Variables on Team Level

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9
Motivation											
1. Valence	3.34	0.64	(.79)								
2. Instrumentality	3.60	0.40	.15	n.a.							
3. Self-efficacy	4.01	0.50	.34**	.25*	(.61)						
4. Trust in system	4.04	0.49	.35***	.20	.58***	(.69)					
5. Trust in persons	4.05	0.61	.49***	.12	.33***	.20	(.93)				
Performance											
6. Subjective performance	83.85	12.39	.58***	.24*	.30**	.16	.63***	(.81)			
7. Subjective satisfaction	3.94	0.70	.51***	.15	.34***	.18	.92***	.62***	(.95)		
8. Expert rating: Form	3.09	0.60	-.08	.05	-.14	-.35**	-.08	.07	-.09	(.72)	
9. Expert rating: Content	2.74	0.80	.28**	-.17	.04	.05	.22	.37***	.25*	.28***	(.55)

Note: *N* = 52 teams. Reliability scores (Cronbach's alpha) are in parentheses. All numbers pertain to Time 2. Results regarding Time 1 were similar. **p* < .10. ***p* < .05. ****p* < .01. *****p* < .001 (two-tailed).

reliable and valid. Furthermore, subjective performance correlates positively with motivational variables, namely with valence ($r = .58, p < .001$), instrumentality ($r = .24, p < .10$), self-efficacy ($r = .30, p < .05$), and interpersonal trust ($r = .63, p < .001$; cf. Table 1). Also, the content dimension, one of the expert ratings, significantly correlates with valence ($r = .28, p < .05$). Correlations among the VIST variables were only moderate (cf. Table 1). Results suggest that the measure of the motivational variables are reliable and nonredundant. Finally, satisfaction correlates significantly with subjective performance ratings ($r = .62, p < .001$) and with the content of the solution proposal ($r = .25, p < .10$), which indicates that a satisfying work context is not in conflict with performance.

Manipulation Check

Responses of OFS users support the successful manipulation of feedback. Every team used the OFS at least once. Measured on an individual level, almost every team member (98%) used the OFS at least once. One third of team members (32.7%) used the OFS for 1 or 2 weeks, and two thirds (67.3%) used the OFS for 3, 4, or 5 weeks. Furthermore, the majority of the students (84%) perceived the OFS as user-friendly. To be more precise, 89% rated the handling and 79% rated the contents as comprehensible.

In open questions, users were asked to describe positive and negative aspects of the OFS. Most of the users rated the possibility of receiving feedback as highly positive, especially regarding the team climate. Feedback was described as providing the possibility of influencing the team partner, as an orientation about the others' performance, and as supporting trust among team members. Furthermore, processes that were initiated by the OFS were mentioned independently by users, especially their need to reflect on the team situation and help in directing the team's attention to relevant aspects of tasks. With regard to the suggestions for improvement, users favored a shorter OFS and called for more concrete and situation specific items. Integrating these type of items should further enhance user acceptance and satisfaction of the OFS.

Effects of Team Process Feedback

To evaluate the effects of team process feedback, the change in subjective ratings and in expert ratings was calculated and compared between the OFS teams and the non-OFS teams. Overall change was computed by subtracting the scores of Time 1 from the scores of Time 2. The advantage of

change measures is that they control for any average differences in the experimental groups prior to the process feedback. Although change scores are known to have higher error variances than either of their components (Cronbach & Furby, 1970), Liker, Augustyniak, and Duncan (1985) demonstrated that the simple comparison of change scores provides consistent estimates of true change. The mean change for the OFS and non-OFS teams can be found in Table 2. The differences between the OFS and non-OFS teams were tested by *t* tests. Because there are a priori assumptions about the direction of the differences, we conducted one-tailed tests. To increase the power of the hypothesis tests, we set a less conservative (rather than conventional) level of probability ($p = .10$; Cohen, 1992).

Hypothesis 1 stated that team process feedback increases the performance of virtual teams. A comparison between the OFS and the non-OFS teams indicates that members of OFS teams show an increase of subjective performance compared to members of non-OFS teams, $t(50) = 2.47$, $p < .01$. This corresponds to a strong effect size of $d = .69$ (cf. Cohen, 1992). Furthermore, OFS teams show higher performance increases in the expert ratings for the form of their solution proposals, $t(49) = 1.82$, $p < .05$; $d = .51$. The expert rating of solution content shows no significant difference between OFS and non-OFS teams, $t(44) = .93$, *ns*.

In Hypotheses 2 and 3, we proposed positive effects of team process feedback on motivational variables and on satisfaction. However, for these variables, there was no significant difference between OFS and non-OFS teams (all $t < 1$, *ns*). Hypothesis 4 suggested that the influence of team process feedback on performance would be mediated by motivation. Because there was no relationship between feedback and motivation, no mediation analysis was computed.

Although there were no significant overall effects of the OFS on motivation and satisfaction, the change scores on the team level show the expected differences (cf. Table 2). We assume that there might be moderating variables influencing the effects of feedback (e.g., initial motivation). In postexperimental discussions, participants supported these assumptions and focused our attention on motivational variables. They reported that an individual's initial motivation might be crucial for the effects of the OFS. Although the course grades of some participants depended on their performance in the project, other students got course credit just by participation, causing differences in the evaluation of the importance of the project. Participants stated that they had to actively manage these differences in motivation across their group. Also, previous studies on feedback indicate that the effects of feedback on performance partly depend on the comparison

Table 2
Change Scores for Online-Feedback-System (OFS) and Non-OFS Groups

Variables	Team Level ^a				Individual Level ^b			
	OFS Group		Non-OFS Group		Lower Motivated Team Members		Non-OFS Group	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Motivation	-0.16	0.47	-0.22	0.53	0.00	0.51	-0.26	0.54
Valence	0.22	0.49	0.13	0.49	0.16	0.61	0.22	0.62
Instrumentality	0.44	0.54	0.38	0.53	0.46	0.64	0.20	0.58
Self-efficacy	-0.03	0.49	0.13	0.37	0.21	0.69	0.08	0.65
Trust in system	0.19	0.53	0.07	0.52	0.22	0.57	-0.10	0.80
Trust in persons								
Performance	5.63	12.97	-2.36	10.15	4.64	10.19	-4.85	16.09
Subjective performance	0.07	0.61	-0.04	0.60	0.13	0.65	-0.21	0.91
Subjective satisfaction	0.14	0.59	-0.19	0.71	—	—	—	—
Expert rating: Form	0.18	0.79	0.13	0.63	—	—	—	—
Expert rating: Content								

Note: Change scores were computed by subtracting the scores of Time 1 from the scores of Time 2. a: *N* = 52. b: *N* = 98.

between self-ratings and outside feedback (Jansen & Vloeberghs, 1999). Therefore, we assume that the effects of the OFS might be influenced by the initial motivation of each individual.

Thus, we classified team members according to their valence rating at Time 1, reflecting their subjective importance rating of the project. For each team, the two team members were contrasted. One member was assigned to the sample of more motivated members, whereas the other was assigned to the sample of less motivated members. We conducted separate analyses for these subsamples. For more motivated team members, change scores did not differ between OFS and non-OFS teams (all $t < 1$, *ns*). The change scores for less motivated team members for the OFS and non-OFS teams can be found in Table 2.

For the subsample of less motivated team members, there are significant differences between the OFS and the non-OFS teams for perceived performance, $t(35) = 2.37$, $p < .01$. Thus, Hypothesis 1, which suggests that team process feedback increases performance, is supported for this subsample.

Hypotheses 2 and 3 suggested that team process feedback increases motivation and satisfaction. Less motivated team members who used the OFS showed an increase in valence, $t(45) = 1.73$, $p < .05$, one-tailed, self-efficacy, $t(46) = 1.49$, $p < .07$, and interpersonal trust, $t(46) = 1.62$, $p < .06$, one-tailed. Also, the satisfaction with the team increased by using the OFS, $t(37) = 1.45$, $p < .08$. In Hypothesis 4, we expected that the influence of team process feedback on performance would be mediated by motivational variables. To test whether effects of the OFS on subjective performance were mediated by the subjective motivational processes, we performed a mediation analysis using multiple regression procedures (Kenny et al., 1998).

To establish process mediation, three different conditions have to be fulfilled. First, the independent variable (OFS use) has to be a significant predictor for the dependent variable (subjective performance), which was supported by a simple regression analysis, $\beta = .34$, $t(48) = 2.41$, $p < .01$, one-tailed (cf. Table 3). Second, the independent variable must be significantly related to the mediator variables, which was verified with a simple regression analysis, indicating that OFS use is a significant predictor for three mediator variables, namely valence, $\beta = .25$, $t(48) = 1.74$, $p < .05$, one-tailed, self-efficacy, $\beta = .22$, $t(48) = 1.49$, $p < .07$, one-tailed, and interpersonal trust, $\beta = .23$, $t(48) = 1.62$, $p < .06$, one-tailed. Third, the effect of the independent variable on the dependent variable must be reduced when both the independent variable and the mediator variable are included as predictors (compared to Equation 1) while the mediator is a significant

Table 3
Mediating Effects of Motivational Variables on the Subjective Performance for Initially Less Motivated Team Members

Variables	Step 1		Step 2	
	β	t	β	t
Online-Feedback-System (OFS) use	.34**	2.41	.18*	1.33
Valence			-.02	-0.11
Self-efficacy			.11	0.83
Interpersonal trust			.50***	3.65
R^2	.12		.37	
Adj. R^2	.10		.31	
ΔR^2	.12		.25	
F for ΔR^2	5.82**		5.45***	

Note: $N = 48$. OFS use was dummy coded (0 = non-OFS, 1 = OFS).

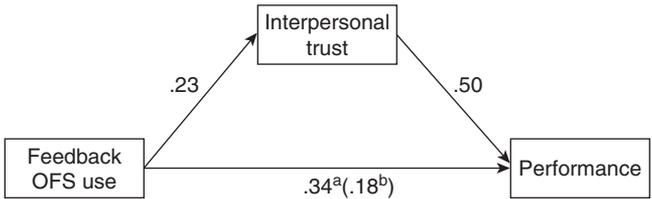
* $p < .10$. ** $p < .05$. *** $p < .01$ (one-tailed).

predictor for the dependent variable. This condition was confirmed with a two-step hierarchical regression with subjective performance as the dependent variable (cf. Table 3).

In Step 1, OFS use was introduced as the independent variable, which is equal to the first condition. In Step 2, the three mediating variables were also introduced as independent variables, which reduced the coefficient for OFS use from $\beta = .34$, $t(48) = 2.41$, $p < .01$ to $\beta = .18$, $t(48) = 1.33$, $p < .10$. Among the mediator variables, the coefficient for interpersonal trust was significant, $\beta = .50$, $t(48) = 3.65$, $p < .001$. Valence ($\beta = -.02$, ns) and self-efficacy ($\beta = .11$, ns) did not have a significant influence on performance. Tolerances for all variables were above .85, indicating that multicollinearity was fairly low. One outlier was detected but was not excluded from the multiple regression because of a low influence on the results. Introducing OFS use explains a significant amount of variance, $\Delta R^2 = .12$, $F(1, 44) = 5.82$, $p < .02$. Introducing the mediator variables also leads to a significant increase of explained variance, $\Delta R^2 = .25$, $F(3, 41) = 5.45$, $p < .001$.

In sum, interpersonal trust was shown to partly mediate the effect of the OFS on performance: OFS groups show higher interpersonal trust than non-OFS groups, and, in turn, trust is positively related to performance. However, because the influence of the OFS on subjective performance could not be reduced to zero and was still marginally significant, only partial mediation

Figure 2
Mediating Effect of Trust for the Influence of Feedback on the Performance of Initially Less Motivated Team Members



Note: Path coefficients represent standardized beta weights (β). Online-Feedback-System (OFS) use was dummy coded (0 = non-OFS, 1 = OFS).

- a. Beta weight for feedback without controlling for trust (simple linear regression).
- b. Beta weight for feedback when trust is controlled for (multiple linear regression).

could be shown. The mediatory role of interpersonal trust is illustrated in Figure 2.

Discussion

The present study aims at demonstrating that regular feedback about ongoing team processes leads to an increase in the motivation, satisfaction, and performance of virtual teams. The study built on the assumption that virtual teams face a lack of information and feedback, especially about team-related aspects. An OFS was used to enhance information and feedback on a regular basis in virtual teams.

In Hypothesis 1, we postulated that team process feedback increases performance. Results support this hypothesis. Increases in performance were found not only in subjective performance measures but also in expert ratings of performance. In Hypothesis 2, we assumed that team process feedback would enhance motivation. Results partly support this hypothesis. There was not an increase in motivation for all teams on a team level, but additional analyses at the individual level revealed that initial motivation served as a moderator variable. Increases in motivation solely occurred for the less motivated team members. When these less motivated members were compared in the OFS and non-OFS groups, data support a beneficial effect of the OFS on valence, self-efficacy, and interpersonal trust.

In Hypothesis 3, we assumed satisfaction-enhancing effects of team process feedback. Results partly confirm this hypothesis. Again, for initially less motivated team members, increases in satisfaction occurred. In Hypothesis 4, we postulated that motivational variables would mediate the effects of the team process feedback on performance. Results confirm this hypothesis for initially less motivated team members. Particularly, interpersonal trust plays a crucial role as a mediator variable.

To summarize, team process feedback increases performance, motivation, and satisfaction in virtual teams. Regarding performance, there was an increase in subjective performance and in the expert ratings of performance on a team level for all teams. However, in regard to motivation and satisfaction, initial motivation appears to be a moderator. Results indicate that while using the OFS, less motivated team members adjusted their motivation and satisfaction perceptions to the level of the more motivated team members. However, in the non-OFS group, no increase or even a decrease of motivation and satisfaction of the less motivated team members occurs. By exchanging information and feedback, less motivated team members might benefit from the positive perceptions of their team partner and increase their motivation and satisfaction.

Results can be further explained with social comparison processes. According to the goal comparison approach (Stroebe, Diehl, & Abakoumkin, 1996), individuals working in a group compare their performance with that of the other group members if the expected performance level is unclear. If group members show different levels of performance, social comparison processes should induce pressure toward a reduction in the discrepancy (Festinger, 1954; Seta, 1982). Working on an important task, the performance level of the strongest member is likely to be perceived as the adequate level. Therefore, less motivated members might increase their effort to match their performance to that of their stronger partners.

Also, studies on outcome feedback (Barr & Conlon, 1994; O'Leary-Kelly, 1998) suggest that team feedback triggers social comparison processes. The authors argue that by team feedback, information about the performances of others is provided. This raises the possibility of social comparison effects (i.e., group members compare their own performance with the performance of others). Social comparison processes are, in turn, expected to influence subsequent individual effort and emotion (O'Leary-Kelly, 1998).

We argue that the findings of the effect of social comparison processes on performance can be transferred to other process and outcome variables.

The feedback provided by the OFS can be assumed to trigger social comparison processes. Results suggest that less motivated team members detected a deficit in motivation while using the OFS and tried to catch up with their more motivated team partner. A precondition for an upward adjustment is the initial perception that the task is important (Stroebe et al., 1996). Participants confirmed a high interest in the project in postexperimental interviews. Thus, the adjustment of motivation can be ascribed to social pressure (Stroebe et al., 1996). Because the task can be characterized as additive (Steiner, 1972), the less motivated team members might have felt pressure to work as hard as their team partners.

Motivation

Regarding individuals' motivation, results support the validity of the VIST model. VIST variables were related to subjective ratings and expert ratings, which supports results found in other studies (Hertel et al., 2004; Hertel, Deter, et al., 2003; Hertel, Niedner, & Herrmann, 2003). Thus, the VIST model provides helpful information in maintaining and enhancing motivation in virtual teams. Looking at the effects of feedback on the team level, we started with an analysis of motivational indicators on team level. However, on an individual level, initial motivation turned out to be a moderator variable. Thus, analyses on the individual level broadened our understanding of the processes induced by feedback. Overall, a differential effect of feedback on motivation and performance occurred, with less motivated team members benefiting more from feedback than more motivated team members.

Further evidence comes from a field study with virtual teams conducted by Kirkman, Rosen, Tesluk, and Gibson (2004). In their study, motivation also moderated the relationship between face-to-face communication and performance. Less motivated teams profited more than highly motivated teams from a greater amount of face-to-face communication. Thus, both studies find less motivated team members to be susceptible to the drawbacks of electronic communication; however, these members also benefit highly from enhancing communication and feedback.

Among the VIST variables, especially interpersonal trust turned out to be of influence. There was evidence for the partial mediation of the feedback-performance relationship by interpersonal trust. Also, it showed a strong relation to perceived performance and satisfaction. Results are in accordance with the generally positive influence of interpersonal trust in electronic work (Jarvenpaa & Leider, 1999).

In recent studies, trust was increased by rich communication media (Bos et al., 2002), getting acquainted activities such as social chat or exchanging photographs (Zheng, Veinott, Bos, Olson, & Olson, 2002), social communication, and reliable and predictable communication (Jarvenpaa & Leidner, 1999). Our study shows that trust is increased by regular team process feedback, specifically the exchange of perceptions about their mutual collaboration. This communication might have helped the team members get acquainted with one another and build up a relationship. However, our teams might have developed a form of "swift trust" (Meyerson, Weick, & Kramer, 1996). Swift trust is likely to be established in teams that have not worked together before and do not have the time to develop trust in a gradual and cumulative way. Such trust appears to be fragile and temporary (Bos et al., 2002). Despite not knowing the specific form of trust present, our study shows that interpersonal trust is a crucial component of motivation and acts as a driving force behind direction, effort, and persistence.

A Comparison to Other Team-Building Interventions

The focus of the present study was the effects of feedback in virtual teams, which we believe supports interpersonal processes in teams. This feedback intervention can be compared to other team-building interventions. Salas, Rozell, Mullen, and Driskell (1999) conducted a meta-analysis on the effects of team-building interventions on performance. Overall, there was no significant effect of team building on performance. By looking at objective and subjective performance measures separately, a nonsignificant tendency for team building to decrease objective performance emerged, whereas team-building interventions led to a significant, albeit small, increase in subjective performance.

In our study, we found a large effect (cf. Cohen, 1992) of the feedback intervention on subjective performance measures and a medium effect for (objective) expert ratings performance measures on the team level. Compared to the results of Salas et al. (1999), these effects are considerable. They underline the importance and effectiveness of feedback interventions in virtual teams.

Limitations and Future Research

This study has several limitations. First, like several others examining peer feedback (e.g., Dominick et al., 1997; Druskat & Wolff, 1999; McLeod & Liker, 1992), we conducted a study with students in an educational context.

We argue that our results have external validity and are generalizable to organizational virtual teams because of similarities between the two contexts on key attributes, such as the high levels of member responsibility, interdependence, and task involvement required in both settings. However, the external validity of the findings reported here must still be tested in work settings with organizational teams.

Second, we investigated newly formed teams during a period of five weeks. Future research should examine the influence of feedback on existing virtual teams during an extended period. Is team process feedback useful for existing teams that might have developed other strategies for exchanging feedback and information and for creating and maintaining common ground? Do teams use feedback differentially in some phases of their teamwork? For example, the research of Gersick (1988) suggested that there are transition points in group work that are associated with changes in the interaction patterns and approaches to the task. Future research should have a closer look at whether or not there are periods when feedback is especially useful.

Third, an important aspect of this study is the focus on team process feedback, which did not include outcome feedback. To our knowledge, it is the first study that shows an increase of performance by giving team process feedback. The feedback literature suggests that performance increases are related to outcome feedback. We might have even found stronger effects if we would have added outcome feedback to the process feedback in the questionnaire. Future research should have a detailed look on the effects of outcome versus process feedback in virtual teams.

Fourth, because we were interested in the effects of team process feedback in virtual teams, we did not examine the influence of team process feedback in conventional, face-to-face teams. However, studying face-to-face teams might have deepened our understanding about the effects of feedback.

Conclusions

In their meta-analysis of feedback intervention studies, Kluger and DeNisi (1996) emphasized the high variance of feedback effects on performance. The results of the present study suggest that feedback does not equally apply to recipients. Instead, initial motivation is a moderator that explains the varying results in feedback intervention studies.

The notion that members have different needs and difficulties is essential for managers and human resource personnel in charge of virtual teams.

Equal handling of members might not be adequate; instead, finding an appropriate contact to members seems more effective. Single team members might profit more than others from regular telephone calls, whereas for others a bimonthly meeting might be sufficient.

Our study shows that team process feedback is useful for virtual teams, although it is especially relevant for less motivated team members. The results show positive effects of the OFS, demonstrating that information and feedback about the team situation is crucial to improving the motivation, satisfaction, and performance of members in virtual teams.

Note

1. Reliability coefficients are Cronbach's alpha (Cronbach, 1951): α_1 pertains to Time 1; α_2 pertains to Time 2.

References

- Ambrose, M. L., & Kulik, C. T. (1999). Old friends, new faces: Motivation research in the 1990s. *Journal of Management*, 25, 231-292.
- Balcazar, F., Hopkins, B. L., & Suarez, Y. (1986). A critical, objective review of performance feedback. *Journal of Organizational Behavior Management*, 7, 65-89.
- Baltes, B. B., Dickson, M. W., Sherman, M. P., Bauer, C. C., & LaGanke, J. S. (2002). Computer-mediated communication and group decision making: A meta-analysis. *Organizational Behavior and Human Decision Processes*, 87, 156-179.
- Bandura, A. (1986). *Social foundations of thought and action*. A social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.
- Barr, S. H., & Conlon, E. J. (1994). Effects of distribution of feedback in work groups. *Academy of Management Journal*, 37, 641-655.
- Bell, B. S., & Kozlowski, S. W. J. (2002). A typology of virtual teams: Implications for effective leadership. *Group and Organization Management*, 27, 14-49.
- Bordia, P. (1997). Face-to-face versus computer-mediated communication: A synthesis of the experimental literature. *The Journal of Business Communication*, 34, 99-120.
- Bos, N., Olson, J. S., Gergle, D., Olson, G. M., & Wright, Z. (2002). Effects of four computer-mediated communications channels on trust development. In *Proceedings of SIGCHI: ACM Special Interest Group on Computer-Human Interaction* (pp. 135-140). New York: ACM Press.
- Buessing, A., & Broome, P. (1999). Vertrauen unter Telearbeit. [Trust during telecommuting]. *Zeitschrift fuer Arbeits-und Organisationspsychologie*, 43, 122-133.
- Burgio, L. D., Engel, B. T., Hawkins, A., McCormick, K., & Scheve, A. (1990). A staff management dystem for maintaining improvements in continence with elderly nursing home residents. *Journal of Applied Behavior Analysis*, 23, 111-118.
- Chidambaram, L. (1996). Relational development in computer-supported groups. *MIS Quarterly*, 20, 143-163.

- Clark, M. C., & Payne, R. L. (1997). The nature and structure of workers' trust in management. *Journal of Organizational Behavior*, *18*, 205-224.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*, 155-159.
- Cronbach, L. J., & Furby, L. (1970). How should we measure "change"—Or should we? *Psychological Bulletin*, *24*, 68-70.
- Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness, and structural design. *Management Science*, *32*, 554-571.
- Dennis, A. R., & Valacich, J. S. (1999, January). *Rethinking media richness: Towards a theory of media synchronicity*. Proceedings of the 32nd Hawaii International Conference on System Sciences, Maui, Hawaii.
- Dominick, P. G., Reilly, R. R., & McGourty, J. W. (1997). The effects of peer feedback on team member behavior. *Group & Organization Management*, *22*, 508-525.
- Dourish, P., & Bellotti, V. (1992). Awareness and coordination in a shared workspace. In M. Mantel & R. Baecker (Eds.), *Proceedings of the ACM Conference on computer-supported cooperative work* (pp. 107-114). New York: ACM Press.
- Druskat, V. U., & Wolff, S. B. (1999). Effects and timing of developmental peer appraisals in self-managing work groups. *Journal of Applied Psychology*, *84*, 58-74.
- Duarte, D. L., & Snyder, N. T. (2001). *Mastering virtual teams*. San Francisco: Jossey-Bass.
- Earley, P. C., Northcraft, G. B., Lee, C., & Lituchy, T. R. (1990). Impact of process and outcome feedback on the relation of goal setting to task performance. *Academy of Management Journal*, *33*, 87-105.
- Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values and goals. *Annual Review Psychology*, *53*, 109-132.
- Farh, J., Cannella, A. A., Jr., & Bedeian, A. (1991). Peer ratings: The impact of purpose on rating quality and user acceptance. *Group & Organization Studies*, *16*, 367-386.
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, *7*, 117-140.
- Foddy, M., Smithson, M., Schneider, S., & Hogg, M. (1999). *Resolving social dilemmas: Dynamic, structural and intergroup aspects*. Philadelphia: Psychology Press.
- Gersick, C. J. (1988). Time and transition in work teams: Toward a new model of group development. *Academy of Management Journal*, *31*, 9-41.
- Goltz, S. M., Citera, M., Jensen, M., Favero, J., & Komaki, J. L. (1989). Individual feedback: Does it enhance effects of group feedback? *Journal of Organizational Behavior Management*, *10*, 77-92.
- Gutwin, C., & Greenberg, S. (1999). The effects of workspace awareness support on the usability of real-time distributed groupware. *ACM Transactions on Computer-Human Interaction*, *6*, 243-281.
- Hackman, J. R. (1987). The design of work teams. In J. Lorsch (Ed.), *Handbook of organizational behavior* (pp. 315-342). Englewood Cliffs, NJ: Prentice Hall.
- Hertel, G. (2002). Management virtueller teams auf der basis sozialpsychologischer theorien: Das VIST modell [Managing virtual teams based on models from social psychology: The VIST model]. In E. H. Witte (Ed.), *Sozialpsychologie wirtschaftlicher prozesse* (pp. 172-202). Lengerich, Germany: Pabst.
- Hertel, G., Deter, C., & Konradt, U. (2003). Motivation gains in computer-supported groups. *Journal of Applied Social Psychology*, *33*, 2080-3004.
- Hertel, G., Geister, S., & Konradt, U. (2005). Managing virtual teams: A review of current empirical research. *Human Resource Management Review*, *15*, 69-95.
- Hertel, G., Kerr, N. L., Scheffler, M., Geister, S., & Messé, L. A. (2000). Exploring the Koehler motivation gain effect: Impression management and spontaneous goal setting. *Zeitschrift für Sozialpsychologie*, *31*, 204-220.

- Hertel, G., Konradt, U., & Orlikowski, B. (2004). Managing distance by interdependence: Goal setting, task interdependence and team-based rewards in virtual teams. *European Journal of Work and Organizational Psychology, 13*, 1-28.
- Hertel, G., Niedner, S., & Herrmann, S. (2003). Motivation of software developers in open source projects: An Internet-based survey of contributors to the Linux kernel. *Research Policy, 32*, 1159-1177.
- Hollingshead, A. B., & McGrath, J. E. (1995). Computer-assisted groups: A critical review of the empirical research. In R. A. Guzzo & E. Salas (Eds.), *Team effectiveness and decision making in organizations* (pp. 46-78). San Francisco: Jossey-Bass.
- Jang, C.-Y., Steinfield, C., & Pfaff, B. (2002). Virtual team awareness and groupware support: An evaluation of the TeamSCOPE system. *International Journal of Human-Computer Studies, 56*, 109-126.
- Jansen, P., & Vloeberghs, D. (1999). Multi-rater feedback methods: Personal and organizational implications. *Journal of Managerial Psychology, 14*, 455-476.
- Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and trust in global virtual teams. *Organization Science, 10*, 791-815.
- Jensen, C., Farnham, S. D., Drucker, S. M., & Kollock, P. (2000, April). *The effect of communication modality on cooperation in online environments*. Proceedings of CHI 2000, The Hague, the Netherlands.
- Karau, S. J., & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology, 65*, 681-706.
- Karau, S. J., & Williams, K. D. (2001). Understanding individual motivation in groups: The collective effort model. In M. E. Turner (Ed.), *Groups at work: Advances in theory and research* (pp. 113-141). Mahwah, NJ: Lawrence Erlbaum.
- Kenny, D. A., Kashy, D. A., & Bolger, N. (1998). Data analysis in social psychology. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology 1* (pp. 233-265). Boston: McGraw-Hill.
- Kenny, D. A., Mannetti, L., Pierro, A., Livi, S., & Kashy, D. A. (2002). The statistical analysis of data from small groups. *Journal of Personality and Social Psychology, 83*, 126-137.
- Kerr, N. L. (1983). Motivation losses in small groups: A social dilemma analysis. *Journal of Personality and Social Psychology, 45*, 819-828.
- Kerr, N. L., & Bruun, S. E. (1983). Dispensability of member effort and group motivation losses: Free-rider effects. *Journal of Personality and Social Psychology, 44*, 78-94.
- Kirkman, B. L., Rosen, B., Tesluk, P. E., & Gibson, C. B. (2004). The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction. *Academy of Management Journal, 47*, 175-192.
- Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin, 119*, 254-284.
- Konradt, U., & Hertel, G. (2002). *Management virtueller teams*. [Management of virtual teams]. Weinheim, Germany: Beltz-Verlag.
- Konradt, U., Hertel, G., & Schmook, R. (2003). Quality of management by objectives, task-related stressors, and non-task-related stressors as predictors of stress and job satisfaction among teleworkers. *European Journal of Work and Organizational Psychology, 12*, 61-79.
- Korsgaard, M. A., & Diddams, M. (1996). The effect of process feedback and task complexity on personal goals, information searching, and the performance improvement. *Journal of Applied Social Psychology, 26*, 1889-1911.
- Kraut, R. E., Fussell, S. R., Brennan, S. E., & Siegel, J. (2002). Understanding effects of proximity on collaboration: Implication for technologies to support remote collaborative

- work. In P. Hinds & S. Kiesler (Eds.), *Distributed work* (pp. 137-163). Cambridge, MA: MIT Press.
- Kraut, R., Galegher, J., & Egido, C. (1987). Relationships and tasks in scientific research collaboration. *Human Computer Interaction*, 3, 31-58.
- Liker, J. K., Augustyniak, S., & Duncan, G. J. (1985). Panel data and models of change: A comparison of first difference and conventional two-wave models. *Social Science Research*, 14, 80-101.
- Lindell, M. K., Brandt, C. J., & Whitney, D. J. (1999). A revised index of interrater agreement for multi-item ratings of a single target. *Applied Psychological Measurement*, 23, 127-135.
- Lipnack, J., & Stamps, J. (1997). *Virtual teams*. New York: John Wiley.
- Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting & task performance*. Englewood Cliffs, NJ: Prentice Hall.
- McAllister, D. J. (1995). Affect- and cognition-based trust as foundations for interpersonal cooperation in organizations. *Academy of Management Journal*, 38, 24-59.
- McGrath, J. E. (1991). Time, interaction, and performance (TIP). *Small Group Research*, 22, 28-147.
- McLeod, P. L., & Liker, J. K. (1992). Process feedback in task groups: An application of goal setting. *Journal of Applied Behavioral Science*, 28, 15-52.
- Mento, A. J., Steel, R. P., & Karren, R. J. (1987). A meta-analytic study of the effects of goal setting on task performance: 1966-1984. *Organizational Behavior and Human Decision Processes*, 39, 52-83.
- Meyerson, D., Weick, K. E., & Kramer, R. M. (1996). Swift trust and temporary groups. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research* (pp. 166-195). Thousand Oaks, CA: Sage.
- Neubert, M. J. (1998). The value of feedback and goal setting over goal setting alone and potential moderators of this effect: A meta-analysis. *Human Performance*, 11, 321-335.
- Odiorne, G. S. (1986). *MBO II: A system of managerial leadership for the 80s*. Belmont, CA: Pitman.
- O'Leary-Kelly, A. M. (1998). The influence of group feedback on individual group member response. In G. R. Ferris (Ed.), *Research in personnel and human resources management* (pp. 255-294). Stamford, CT: JAI.
- Olson, G. M., & Olson, J. S. (2001). Distance matters. *Human Computer Interaction*, 15, 139-179.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879-903.
- Riordan, C. M., & Weatherly, E. W. (1999). Defining and measuring employees' identification with their work groups. *Educational and Psychological Measurement*, 59, 310-324.
- Salas, E., Rozell, D., Mullen, B., & Driskell, J. E. (1999). The effect of team building on performance: An integration. *Small Group Research*, 30, 309-329.
- Seta, J. (1982). The impact of comparison processes on coactors task performance. *Journal of Personality and Social Psychology*, 42, 281-291.
- Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin*, 2, 420-428.
- Staples, D. S., Hulland, J. S., & Higgins, C. A. (1999). A self-efficacy theory explanation for the management of remote workers in virtual organizations. *Organization Science*, 10, 758-776.
- Steiner, I. D. (1972). *Group processes and productivity*. New York: Academic Press.
- Stroebe, W., Diehl, M., & Abakoumkin, G. (1996). Social compensation and the Koehler effect: Toward a theoretical explanation of motivation gains in group productivity. In

- E. Witte & J. Davis (Eds.), *Understanding group behavior: Consensual action by small groups* (pp. 37-65). Mahwah, NJ: Lawrence Erlbaum.
- Tubbs, M. E. (1986). Goal setting: A meta-analytic examination of the empirical evidence. *Journal of Applied Psychology, 71*, 474-483.
- Warkentin, M. E., Sayeed, L., & Hightower, R. (1997). Virtual Teams versus face-to-face teams: An exploratory study of a Web-based conference system. *Decision Science, 28*, 975-996.
- Weisband, S. (2002). Maintaining awareness in distributed team collaboration: Implications for leadership and performance. In P. Hinds & S. Kiesler (Eds.), *Distributed work* (pp. 311-334). Cambridge, MA: MIT Press.
- Wohlberg, J. W., Gilmore, G. E., & Wolff, S. B. (1995). *OB in action: Cases and exercises*. Boston: Houghton Mifflin.
- Zheng, J., Veinott, E., Bos, N., Olson, J. S., & Olson, G. M. (2002). Trust without touch: Jumpstarting long-distance trust with initial social activities. In *Proceedings of SIGCHI: ACM Special Interest Group on Computer-Human Interaction* (pp. 141-146). New York: ACM Press.
- Zumbach, J., Muehlenbrock, M., Jansen, M., Reimann, P., & Hoppe, H.-U. (2002). Multi-dimensional tracking in virtual learning teams. In G. Stahl (Ed.), *Computer support for collaborative learning: Foundations for a CSCL community* (pp. 650-651). Hillsdale, NJ: Lawrence Erlbaum.

Susanne Geister holds a PhD in work and organizational psychology from the University of Kiel, Germany, and specializes in feedback and collaboration processes in virtual and conventional teams. She presently works in the organization department of a finance company in Germany.

Udo Konradt is full professor of work, organizational and consumer psychology at the University of Kiel, Germany. He holds a PhD in psychology from the University of Bochum, Germany. The main topics of his research include online personnel selection, leadership in virtual teams, and e-learning.

Guido Hertel is full professor of work, industrial, and organizational psychology at the University of Wuerzburg, Germany. The current topics of his research are collaboration in distributed (virtual) teams, process gains in groups, electronic human resource management, and work motivation across the life span. He holds a PhD in psychology from the University of Heidelberg, Germany, and has worked as a consultant for teamwork in various business organizations.