SATISFACTION IN VIRTUAL TEAMS IN ORGANIZATIONS

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ABSTRACT

Teams in organizations are no longer pure virtual or pure face-to-face teams, but fall into the large hybrid category of those who use technology according to the needs of their task and team structure. Considering the assumption that the level of a team's virtuality may influence members' satisfaction, we explored the effects of team virtuality on member satisfaction in a sample of virtual team members in organizations (N = 159) using an online questionnaire. We defined two dimensions of virtuality: the proportion of e-mail vs. face-to-face communication and the proportion of co-located team members. By assessing satisfaction with different measures we were able to describe distinctive relationships between level of virtuality and member satisfaction. We found that virtual team members reported rather low job satisfaction. Results showed negative relationships between team virtuality and job satisfaction and satisfaction with working relationships in the team, respectively. We found no effects of team virtuality on resigned attitude towards one's job, satisfaction with team task performance, and satisfaction with computer-mediated communication. However, context variables other than level of virtuality had stronger effects on job satisfaction. Especially trust in other team members and adequate management information policies improved member satisfaction.

Keywords: Virtual teams, level of virtuality, member satisfaction

1 INTRODUCTION

Job satisfaction is related to a variety of important job-related criteria such as turnover, organizational citizenship behavior, absence, health and well-being and antisocial behavior (Spector, 1997). The relationship between job satisfaction and performance was found to be r = .30 (Judge, Thoresen, Bono, & Patton, 2001). Although these correlations are usually not very high, they have significant implications in practice. Baillod and Semmer (1994) for example reported that only 6.5% of the most satisfied, but 47.8% of the most unsatisfied workers quit their job within one year, with the correlation between the two concepts only being r = .37.

How satisfied are members of virtual teams? In general, levels of member satisfaction are reported to be lower in virtual than in face-to-face teams (Martins et al., 2004). But much of this research is based on short-term, ad-hoc groups performing contrived tasks and is therefore not directly applicable to organizational teams (Kirkman & Mathieu, 2005). In today's organizations, most of the teams are neither pure virtual teams nor pure face-to-face teams but are likely to fall into a hybrid category (Griffith et al., 2003). Therefore, it was proposed recently to include the *level of virtuality* in the description of virtual teams (Griffith & Neale, 2001; Griffith et al., 2003; Hertel, Geister, & Konradt, 2005; Kirkman & Mathieu, 2005). Martins, Gilson, and Maynard (2004), for example, define virtual teams as "teams whose members use technology to varying degrees in working across locational, temporal, and relational boundaries to accomplish an interdependent task" (p. 808). In ongoing virtual teams, member satisfaction may be related to the level of virtuality. In such teams, shared (face-to-face) team experience and common knowledge facilitate team processes and interpersonal relations (Klimoski & Mohammed, 1994), enabling virtual teams to overcome to some degree the limitations inherent in computer-mediated communication (Alge, Wiethoff, & Klein, 2003; Hollingshead & McGrath, 1995; Walther, 2002). Thus, computer-mediated communication may have less negative impact on member satisfaction in real-world teams in organizations than in short-term, ad-hoc laboratory teams.

The present study contributes to the growing literature on virtual teams in two aspects. First, we propose a measure for the *level of virtuality* and discuss its relationship with related measures such as group size, member competence, and team tenure (Kirkman & Mathieu, 2005) in virtual teams in organizations. Second, we explore the relationship between level of virtuality and measures of *member satisfaction*. We included several measures of member satisfaction to distinguish general job satisfaction from more specific satisfaction measures related to the team and the task, as well as to computer-mediated communication.

2   LEVEL OF VIRTUALITY AND MEMBER SATISFACTION

Level of Virtuality

Earlier research has identified the differences between virtual and co-located (face-to-face) teams, assuming that teams can be viewed either as virtual or face-to-face. The majority of definitions include the notion that virtual teams rely on computer-mediated communication while crossing several boundaries, such as geography, time, and organization (e.g Bell & Kozlowski, 2002). Virtual teams are not constrained to one physical location but can be located throughout the world (e.g. Montoya-Weiss, Massey, & Song, 2001). Modern organizational teams have access to a variety of communication technologies. Computer mediated communication, especially the use of e-mail, has become standard in many work teams. Even co-located teams may choose to share information and documents via e-mail or the intranet of their organization. Many virtual teams, on the other hand, meet face-to-face, at least initially, or schedule periodic face-to-face meetings (Kirkman & Mathieu, 2005). Therefore it was recently proposed to define virtual teams in less absolute terms. Instead of contrasting pure virtual with pure traditional teams descriptions including their level of virtuality were proposed.

Griffith and colleagues (2003), for example, have proposed three dimensions of virtualness, (1) the level of technological support used by the team, (2) the percentage of work that the team does with its members distributed across time and space, and (3) the distribution of the physical locations occupied by the team members. Pure traditional teams then form only one extreme. They are located at the origin of the graph, with all three dimensions close to zero. Pure virtual teams form the other extreme and are located on a plane with only two dimensions; they never meet face-to-face. However, according to Griffith and colleagues (2003), "most of today's organizational teams are likely to fall into the large hybrid category of teams composed of members who interact over time, according to the needs of the moment, and through media, with the amount of face-to-face contact determined by their own adaptation and structuration of the process" (p. 268).

Kirkman and Mathieu (2005) have proceeded even further in arguing that geographic dispersion is not a prerequisite for team virtuality, but is likely to lead teams to adopt more virtual means of coordination. They have argued that even co-located members can communicate and coordinate in a highly virtual manner. Although these authors have defined team virtuality on three dimensions, they have not included a geographical dimension. Instead they have proposed the following dimensions: (1) the extent of use of virtual tools (e-mail, videoconferencing, group decision support systems, etc.), (2) the amount of informational value provided by such tools, and (3) the synchronicity of team member virtual interaction. If geographical distribution is no longer a key element in the definition of virtual teams, but one of many antecedents of team virtuality, other antecedents may also influence team virtuality. Kirkman and Mathieu (2005) have proposed a model of three categories of antecedents, contextual features (e.g. proportion of co-located members and team size),

task-media-member compatibility (e.g. task complexity and team member competencies), and temporal dynamics (e.g. team evaluation and maturation) that are likely to increase or decrease team virtuality.

In following this argumentation (Bell & Kozlowski, 2002; Griffith et al., 2003; Kirkman & Mathieu, 2005) we suggest measuring the level of team virtuality with the two more traditional dimensions, spatial distance und communication media. However, to take into account effects of potential antecedents of virtuality (Kirkman & Mathieu, 2005), we control for team size, media competence and team tenure.

Member Satisfaction

Research on satisfaction in virtual teams is still sparse. What we know is often based on short term, ad-hoc, or student teams communicating either purely virtually or purely face-to-face. The satisfaction measure is often related to the communication media or to well defined outcomes, such as group decision making quality (Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002). In their review, Martins and colleagues reported that the satisfaction in virtual interaction (compared to face-to-face interaction) is often low. However, the effect of the communication media is often moderated by the nature of the task and the composition of the team. Baltes and colleagues (2002) reported in their meta-analysis a decrease in members' satisfaction in computer-mediated groups only when members were anonymous, when discussion time was limited and when groups became larger. Members of computer-mediated groups were less satisfied than members of face-to-face groups when they performed intellective or decision making tasks.

Another moderator may be the team members' experience with electronic communication media. When team members becomefamiliar with computer-mediated communication, its negative effects may be lower (Hollingshead & McGrath, 1995; Walther, 2002). We can therefore assume that in real-world teams, satisfaction levels may be higher than in ad hoc laboratory teams. Although research on satisfaction in real-world teams is still sparse, there are some indications pointing in that direction. For example, Hertel and colleagues (2005) reported higher member satisfaction in existing virtual teams when members had more opportunities to meet face-to-face, more non-job-related communication and more constructive conflict management.

In the present study we explore virtual team member satisfaction in real-world teams in organizations using several measures for member satisfaction. On a more general level, we distinguish between general *job satisfaction* and *resigned attitude* towards work, as suggested by the concept of different forms of work satisfaction (Bruggemann, 1974; Kälin, Semmer, Elfering, Tschan, et al., 2000). On a more specific level, we explore satisfaction with the quality of team task performance (*task satisfaction*), with the quality of the working relationships in their team (*team satisfaction*), and with computer mediated communication (*cmc satisfaction*). We expect a negative relationship between the level of virtuality and the satisfaction measures.

Context Factors

Real-world teams are embedded in an organizational context that may influence member satisfaction in virtual teams (Baltes et al., 2002; Hertel et al., 2005; Martins et al., 2004). Virtual teams allow organizations to access unique, highly specialized experts (Bell & Kozlowski, 2002). Virtual teams are often cross-functional and self-managing, with authority and responsibility for many of their tasks and outcomes (Hackman, 2002). Members of virtual teams are mutually accountable and work interdependently to solve problems and carry out tasks (Hertel, Konradt, & Orlikowski, 2004; Kirkman & Mathieu, 2004). The management's role is often restricted to setting the direction for the team and providing the team with the resources and support needed (Mannix, Griffith, & Neale, 2002). However, virtual cooperation also enhances the level of vulnerability, uncertainty, and ambiguity in teams. Thus, in virtual teams, trust among team members is pivotal (Jarvenpaa & Leidner, 1999). Recent research has also begun to corroborate the important role of organizational context in virtual teams (Hertel et al., 2005; Hertel et al., 2004; Jarvenpaa & Leidner, 1999; Kirkman, Rosen, Tesluk, & Gibson, 2004; Premkumar, 2003).

In the present study we explore the influence of the level of virtuality on team satisfaction in a broad variety of teams in organizations. To control for the influence of contextual factors other than level of virtuality, we include measures on the individual, team, and organizational level in our analysis. On the individual level, we include attitudes towards electronic media. On the team level, we control for the degree of trust in team mates, the degree of task interdependence, and the degree of team autonomy. Finally, on the organizational level, we control for information management and management support for technology use. We expect a negative relationship between the level of virtuality and the satisfaction measures even after controlling for context variables.

3   METHOD

Participants

We contacted members of organizations in close geographical proximity to each university first by e-mail to explain our research interest in virtual teams in very general terms and a couple of days later by telephone to identify members of virtual teams. Originally, 184 respondents began to fill in the online questionnaire. However, 25 respondents stated not being a member of a virtual team and were therefore not allowed to complete the questionnaire (see below). Of these 159 respondents, 93 completed higher studies (university, university of applied sciences), 50 completed an apprenticeship and 16 a basic education. Respondents had an average age of 38.3 years (SD = 10.8) and two thirds were men. Average team size was 11.7 (SD = 12.8; *median* = 6 members) and average tenure in the team was 4.6 (SD = 5.0) years.

Procedure and questionnaire

The online-questionnaire existed in a French as well as a German version; participants could choose which version they preferred to fill in. Items from original English scales and new developed items were translated and retranslated until no discrepancies could be detected. The questionnaire opened with an introduction page, where we gave a short definition of virtual teams. Questions appeared in groups, only when all questions were answered the continue button would open the next page. The first set of questions aimed to make their workplace, their virtual team, and computer-mediated communication salient. We then asked, if they had colleagues with whom they were often cooperating virtually and of which they would think of as their team. Only when participants answered in the positive, the questionnaire would continue. A text appeared that explained that they should answer all following questions relative to their team.

Level of virtuality

We asked team members how often they communicated with which media. Respondents communicated more often via e-mail ($M = 4.43$, $SD = 79$) than face-to-face ($M = 3.91$, $SD = 1.07$), $t(158) = 4.655$, $p < .001$, or via telephone ($M = 4.09$, $SD = .99$), $t(158) = 3.909$, $p < .001$. They hardly ever communicated via video-conference ($M = 1.21$, $SD = .58$), or chat ($M = 1.40$, $SD = .90$); intranet is in-between ($M = 2.92$, $SD = 1.54$). Team members reported to receive 23.7 ($SD = 22.3$) e-mails per day and to send 16.7 ($SD = 13.2$) e-mails per day.

To assess the level of virtuality of the teams, we followed the two dimensions proposed by Bell and Kozlowski (2002), spatial distance und communication media. We assessed spatial distance from the point of view of the respondent as the proportion of co-located team members (who worked in the same building as the respondent) relative to all team members, independently of their individual location (e.g. all in one country or distributed over the world). Similarly, we assessed communication media as the proportion of e-mail vs. face-to-face communication. We decided for this simple measure to facilitate interpretation.

The proportion of face-to-face versus e-mail communication ($M = .93$, $SD = .39$) and the proportion of co-located team members ($M = .61$, $SD = .40$) were arcsine transformed, z-standardized and then combined. The resulting values form a continuum from low level of virtuality to high level of virtuality (see figure 1). In absolute terms, in 64 teams all members were *co-located*, whereas in only 24 teams all members were *dispersed*. Co-located team members communicated more face-to-face ($M = 4.47$, $SD = .69$) than geographically dispersed team members ($M = 3.17$, $SD = 1.01$), $t(31.4) = -5.841$, $p < .001$. However, although co-located team members communicated less via e-mail ($M = 4.19$, $SD = .89$) than geographically dispersed team members ($M = 4.54$, $SD = .59$), the difference here is smaller $t(86) = 1.806$, $p < .10$.
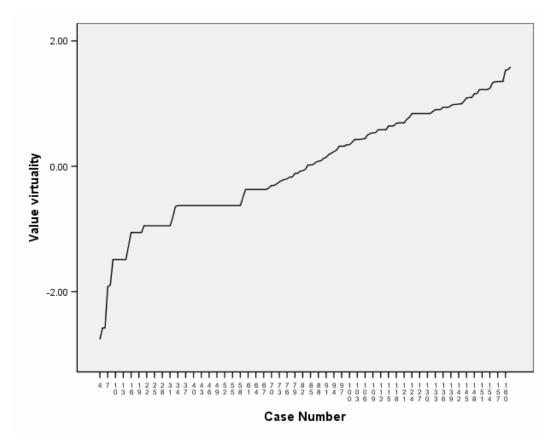
Figure 1. The level of virtuality of all members' teams depicted as a continuum from low level of virtuality (all members co-located and more face-to-face than computer mediated communication, to high level of virtuality (no members co-located, more computer mediated than face-to-face communication

Dependent Variables: Member satisfaction

We assessed satisfaction with five different measures. Job related attitudes distinguish between general job satisfaction and a resigned attitude towards the job, as suggested by the concept of different forms of job satisfaction in a motivational frame of reference (Bruggemann, 1974; Kälin et al., 2000). With job satisfaction the aspiration level is maintained, with resigned attitude the aspiration level is lowered. Job satisfaction and resigned attitude were measured with a 7-point Lickert-type format that went from practically never (1) to practically always (7). *Job satisfaction* was measured with three items. The first item asked "How satisfied are you with your job in general?" and was answered on a 7-point scale with a Kumin faces scale symbolizing very unsatisfied to very satisfied. *Resigned attitude* was measured with three items, e.g. "My job situation is not perfect but it could be worse". Two scales measured satisfaction with the quality of team task performance and with the quality of relationships within the team with a 7-point Lickert-type format that went from disagree completely (1) to agree completely (7). *Task satisfaction* was measured with eight items developed by the authors, e.g. "The team works efficiently and goal directed". *Team satisfaction* was measured with four items developed by the authors, e.g. "I am satisfied with the working relationships in

our team". CMC s*atisfaction* was measured with one item, again with Kumin faces symbolizing very unsatisfied (1) to very satisfied (7).

Principal component analysis with Varimax rotation revealed the presence of four factors with eigenvalues exceeding 1, explaining together 72.4% of the variance. The first factor explained 43.4%, and was composed of the eight task satisfaction items (minimal factor loading was .70, *Cronbach's* α = .94). The second factor explained 11.6%, and was composed of the four team satisfaction items (minimal factor loading was .78, *Cronbach's* α = .89). The third factor explained 10.2% of the variance and was composed of three job satisfaction items and one (reversed) resigned attitude item (minimal factor loading was .70). Finally, the fourth factor explained 7.1% of the variance and included the remaining two (reversed) resigned attitude items (minimal factor loading was .72). We decided to integrate the job satisfaction and resigned attitude items into the two initial scales, which we can justify with the resulting *Cronbach's* α = .79 for job satisfaction and α = .61 for resigned attitude that are similar to those reported by Kälin and colleagues (2000; α = .65 and .74 for job satisfaction, and α = .55 and .61 for resigned attitude).

Antecedents of virtuality and context variables

We controlled not only for demographic variables but also for potential antecedents of team virtuality and context variables. Since we used a French and a German version of the questionnaire, we also controlled for the language of the questionnaire. Age, sex, and language, and the potential antecedents of team virtuality--team size, media competence, and team tenure--were measured with one item. As context variables we measured on the individual level the respondents' attitudes towards electronic media. On the team level, we controlled for trust in team mates, team autonomy, and task interdependence. Finally, on the organizational level, we controlled for information management and management support for technology use. All scales used a 7-point Lickert-type format that went from absolutely disagree (1) to absolutely agree (7). We translated all items into French and German and adapted, if necessary, the wording using the team as the appropriate referent ("our team", see also Klein & Kozlowski, 2000; Serva, Fuller, & Mayer, 2005), to establish the team's context. *Attitudes towards electronic media* were measured with four items developed by the authors, e.g. "I like to work with electronic media". *Trust in team mates* was measured with eight items derived from Jarvenpaa and colleagues (1998), e.g. "I can rely on those with whom I work in this group". *Team autonomy* was measured with six items derived from Kirkman and Rosen (1997; see also Thomas & Tymon, 1993), e.g. "The team determines how things are done on the team". *Task interdependence* was measured with 4 items: Three items were derived from Liden, Wayne, and Bradway (1997; see also Pearce & Gregersen, 1991), e.g. "Team members work closely with each other in doing their work". A fourth item was added by the authors "To be able to perform the own tasks, it is important to share documents and information with other team members". Information management was measured with four items developed by the authors, e.g. "I can get important information at any time". Finally, *management support for technology use* was measured with three items derived from

Premkumar (2003), e.g. "The management has allocated enough resources for adoption of the new technologies".

Principal component analysis with Varimax rotation revealed the presence of 6 factors with eigenvalues exceeding 1, explaining together 67.1% of the variance. These factors corresponded to the six initial scales with all factor loadings exceeding accepted standards of > 5. One item from the task interdependence scale loaded higher in the trust factor, but with less than .5 on the task interdependence factor. We excluded this item. The first factor explained 29.8%, and was composed of the eight trust items (minimal factor loading was .66, *Cronbach's* α = .92). The second factor explained 10.7%, and was composed of the team autonomy items (minimal factor loading was .66, *Cronbach's* α = .83). The third factor explained 8.3%, and was composed of the four information management items (minimal factor loading was .65, *Cronbach's* α = .84). The fourth factor explained 7.3%, and was composed of the four attitudes items (minimal factor loading was .71, *Cronbach's* α = .81). The fifth factor explained 6.2%, and was composed of the three management support items (minimal factor loading was .84, *Cronbach's* α = .90). The final factor explained 4.9%, and was composed of the three remaining task interdependence items (minimal factor loading was .76, *Cronbach's* α = .75).

4   RESULTS

Table 1 presents the means, standard deviations and intercorrelations of the level of virtuality measures, the three antecedents of virtuality measures, and the frequencies of media use. Note that level of virtuality and its two dimensions, proportion of co-located members and proportion of email vs. face-to-face communication are negatively correlated. Higher levels of virtuality correlate with fewer co-located members and with less face-to-face, but with more e-mail communication. Higher levels of virtuality also correlate with more telephone and more chat communication, but are not related to videoconferencing. Similarly, a higher proportion of email communication is related to more telephone and more chat communication. In addition, a higher proportion of co-located team members is related to more face-to-face communication and more intranet use, but to less e-mail and less chat communication. Finally, level of virtuality is not related to the three proposed antecedents of virtuality measures, team size, media competence, and team tenure.

Table 2 presents the means, standard deviations and intercorrelations of context, level of virtuality and satisfaction measures. Mean satisfaction levels are lower for job satisfaction (*M* = 4.72, *SD* = 1.24) than for the other satisfaction measures (resignative attitude items are negatively formulated, *M* = 2.87, *SD* = 1.21; task satisfaction, *M* = 5.38, *SD* = .86; team satisfaction, *M* = 5.28, *SD* = 1.21; satisfaction with CMC (*M* = 5.40, *SD* = .97). Level of virtuality is (negatively) correlated only with job satisfaction and team satisfaction, but it is not correlated with resigned attitudes, task satisfaction and satisfaction with computer mediated

communication. In addition level of virtuality is not correlated with any of the context measures.

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	Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11
1.	Virtuality	-0.02	0.90	-										
2.	Proportion ftf/e-mail	0.09	0.04	-.886**	-									
3.	Proportion co-located	0.61	0.40	-.869**	.541**	-								
4.	Size	11.69	12.78	.046	-.052	-.014	-							
5.	Competence	3.99	0.68	.022	-.011	.032	-.229**	-						
6.	Team tenure	4.62	4.98	-.041	.054	.008	.523**	-.106	-					
7.	Freq. face-to-face	3.91	1.07	-.711**	.719**	.571**	.022	.104	.056	-				
8.	Freq. telephone	4.09	0.99	.164*	-.160*	-.041	.072	.067	-.024	-.003	-			
9.	Freq. videoconference	1.21	0.57	.153	-.094	-.120	-.077	.020	.004	-.040	.054	-		
10	Freq. chat	1.40	0.90	.246**	-.267**	-.160*	-.111	.242**	-.094	-.277**	.142	.109	-	
11	Freq. e-mail	4.43	0.79	.626**	-.760**	-.280**	.054	.158*	-.057	-.169*	.262**	.107	.157	-
12	Freq. intranet	2.92	1.55	-.090	.007	.219**	.009	.108	.007	.095	.244**	.169*	.133	.117

*p < .05. ***p* < .01. *N* = 159.

Table 1: Means, standard deviations and intercorrelations; communication media and level of virtuality measures.

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11
1.	Attitudes	5.29	.98	-										
2.	Trust	5.63	1.00	.293**	-									
3.	Autonomy	4.76	1.05	.256**	.376**	-								
4.	Interdependence	5.68	.94	.134	.298**	.048	-							
5.	Info management	4.94	1.15	.177*	.489**	.389**	.080	-						
6.	Mangt. support	5.28	1.23	.181*	.197*	.272**	-.003	.371**	-					
7.	Virtuality	-.02	.90	.037	-.119	.132	-.068	-.023	-.055	-				
8.	Job satisfaction	4.72	1.24	.176*	.475**	.259**	.097	.594**	.330**	-.173**	-			
9.	Resigned attitude	2.78	1.21	-.216**	-.306**	-.266**	.098	-.519**	-.236**	.016	-.407**	-		
10	Task satisfaction	5.38	.86	.297**	.711**	.345**	.156**	.567**	.258**	-.020	.448**	-.334**	-	
11	Team satisfaction	5.28	1.21	.221**	.670**	.387**	.264**	.362**	.155	-.209**	.319**	-.187*	.509**	-
12	Satisfaction CMC	5.40	.97	.297**	.379**	.328**	.005	.472**	.441**	-.019	.509**	-.251**	.398**	.183*

*p < .05. **p < .01. N = 159.

Table 2: Means, standard deviations and intercorrelations; context, level of virtuality and satisfaction measures.

Interestingly, there are no statistically significant differences between the all co-located and all geographically dispersed team members in the satisfaction measures and in four of the five context measures. However, co-located teams have less team autonomy (M = 4.59, SD = .97) than geographically dispersed teams (M = 5.13, SD = 1.19), $t(86)$ = 2.172, p < .05.

We expected that level of virtuality was negatively associated with member satisfaction, even after controlling for context variables. To test this expectation, we performed a hierarchical multiple regression analysis for all five satisfaction measures. In step 1, we entered the control variables (age, sex, and the language of the questionnaire) and the three antecedents of team virtuality measures (team size, media competence, and team tenure), in step two we entered level of virtuality and in step three we entered the six context variables (attitudes towards electronic media, trust in team mates, team autonomy, task interdependence, information management and management support for technology use). All results are depicted in table 3. Level of virtuality is a statistically significant predictor only for job satisfaction (ΔR^2 = .038, p < .05) and team satisfaction (ΔR^2 = .045, p < .01), but not for the other three measures for member satisfaction. When the context variables are entered into the equation, level of virtuality is still a statistically significant predictor for job satisfaction and team satisfaction although the strength of the effect is somewhat reduced. Results indicate effects of some of the five context variables. Inspection of the beta values reveals that especially trust in team mates and information management predict member satisfaction. *Job satisfaction* is higher when team members more trust their team mates, when they perceive the information management in their organization as better and when the level of virtuality is lower. *Resigned attitude* is lower, when they more trust their team mates, when there is less task interdependence in the team and especially when they perceive the information management as better. *Task satisfaction* is higher when they more trust their team mates and perceive the information management as better. *Team satisfaction* is higher when they more trust their team mates, when the team has more team autonomy, and when the level of virtuality is lower. Finally, *cmc satisfaction* is higher when the team members perceive the information management and management support for technology use as being higher, but also to some lower degree when team members have more positive attitudes towards electronic media and more trust in team mates.

We performed the same analysis with the two dimensions of team virtuality--proportion of e-mail communication and proportion of co-located members--as independent variables to explore which aspect of the level of virtuality measure might be responsible for the effects on member satisfaction. Again, virtuality measures are only significant predictors for job satisfaction and team satisfaction. With job satisfaction as the dependent variable, proportion of co-located members is a significant predictor (ΔR^2 = .031, p < .01) and to a lower degree also proportion of e-mail communication (ΔR^2 = .010, p < .10). With team satisfaction as the dependent variable, proportion of co-located members (ΔR^2 = .023, p < .01) and proportion of e-mail communication (ΔR^2 = .016, p < .05) are significant predictors.

Dependent Variables	Job satisfaction			Resigned attitude			Task satisfaction			Team satisfaction			CMC satisfaction		
	β	R_{adj}^2	ΔR^2	β	R_{adj}^2	ΔR^2	β	R_{adj}^2	ΔR^2	β	R_{adj}^2	ΔR^2	β	R_{adj}^2	ΔR^2
Step 1: Control variables[1]		.040[+]	.076[+]		.080*	.115*		.109*	.143*		.058*	.094*		.000	.038
Step 2:		.073*	.038*		.076*	.002		.104*	.001		.098*	.045*		-.005	.001
• Virtuality	-.197*			.041			-.037			-.213*			-.034		
Step 3		.429*	.361*		.366*	.301*		.592*	.482*		.499*	.402*		.313*	.331*
• Virtuality	-.148*			.018			.054			-.154*			-.004		
• Attitudes	.062			-.108			.013			-.001			.136[+]		
• Trust	.222*			-.141[+]			.556*			.568*			.159[+]		
• Autonomy	.006			-.006			-.068			.183*			.063		
• Interdependence	-.007			.185*			-.051			.055			-.086		
• Info management	.419*			-.404*			.286*			.018			.253*		
• Mangt. support	.099			-.084			.059			-.013			.275*		

[1] Controlled for age, sex, team tenure, own competence, team size and questionnaire language.

[+] $p < .10$. * $p < .05$. $N = 159$.

Table 3: Hierarchical multiple regression analysis for the effects of level of virtuality and context on member satisfaction measures.

5   DISCUSSION

In this study, we had two goals: to assess the level of virtuality in real-world virtual teams and to explore the relationship between level of virtuality and virtual team members' satisfaction. We performed a cross sectional questionnaire study with respondents from a wide variety of organizations and teams in Germany and Switzerland. These respondents perceived themselves as being a member of a virtual team according to the definition we proposed: People with whom they collaborated in one or more tasks and with whom they communicated to varying degrees computer mediated. Following Kirkman and Mathieu (2005) we did not include geographic dispersion as a prerequisite for team virtuality when recruiting respondents, but used it to describe the level of virtuality of the teams and analyzed its role in predicting member satisfaction.

Team virtuality

We assessed the level of virtuality with the two dimensions that are most often proposed in the literature, spatial distance and level of technological support (Bell & Kozlowski, 2002; Griffith et al., 2003; Kirkman & Mathieu, 2005). Spatial distance was assessed as the proportion of team members working in the same building as the respondent. Level of technological support was assessed as the proportion of e-mail vs. face-to-face communication, without accounting for other communication media. The two measures, proportion of e-mail and proportion of co-located members, were highly correlated, as predicted by Kirkman and Mathieu (2005) who proposed that geographical dispersion of team members would lead teams to adopt more virtual means.

Combining the two components of team virtuality--spatial distance and level of technological support--revealed that the respondents were members of teams that were whether purely traditional nor purely virtual, but hybrid (Griffith et al., 2003), spread on a continuum between these two extremes. These findings support the argumentation of Griffith and colleagues (2003). Towards one end of the continuum respondents with co-located team mates were situated (40.3% of all respondents). Also these respondents often communicated via e-mail with their team mates. No respondent claimed to never communicate via e-mail with his or her team mates. Thus, following Griffith and colleagues' definition of traditional teams, none of the teams in our sample fell into this category. This finding supports Kirkman and Mathieu's (2005) argumentation that co-located team members may choose to communicate in a highly virtual manner for a variety of reasons, even when they are in close physical proximity. Towards the other end of the continuum respondents with geographically dispersed team mates were situated (15.1% of all respondents). These respondents also communicated face-to-face with their team mates, but significantly less often than respondents from co-located teams. Only one respondent claimed to never communicate face-to-face with his or her team mates. Thus, again following Griffith and colleagues' (2003) definition of pure virtual teams, only one team of our sample would fall into this category. However, we found no

relationship between the level of virtuality measure and proposed antecedents of virtuality such as team size, media competence and team tenure (Kirkman & Mathieu, 2005). Although we believe that we captured the two most important factors to assess virtuality, this measure may be too straightforward. For example, we did not integrate the amount of informational value or the level of synchronicity of the communication media (Kirkman & Mathieu, 2005), since only 13.2% of the teams used videoconferencing systems (and if they did, they did it rarely) and 19.5% used chat (again rarely or sometimes).

Member satisfaction

How satisfied are members of virtual teams? We measured satisfaction with five scales to assess different aspects of satisfaction. Two measures aimed at general work satisfaction three other measures aimed at team and media related aspects. Job satisfaction and resigned attitude measure two aspects of general work satisfaction (Bruggemann, 1974). If team members were not very happy with working computer mediated, but had no choice to do so, we would expect resigned attitude being high ("it could be worse"). However, this is not the case. Job satisfaction is relative low, but also resigned attitude is low. Relative low here means that compared to the often reported 70 or 80% of rather satisfied coworkers (Semmer & Udris, 2004), only 50.9% of the respondents in our sample are at least rather satisfied (scale levels 5 to 7 in a scale from 1 of 7). The corresponding value for the (reversed) resigned attitude scale is 65.4%. Since job satisfaction is associated to important job-related criteria such as turnover, organizational citizenship behavior, absence, health and well-being and antisocial behavior (Spector, 1997) and to performance (Judge et al., 2001), these results are rather alarming. Results are less dramatic for the team and media related measures: 70.4% of the respondents are rather satisfied with their team task performance and 69.2% with the working relationships in their team. Finally, 85.2% are rather satisfied with computer mediated communication.

Is the level of virtuality related to these satisfaction measures? We found, even after controlling for other contextual factors, that members of more virtual teams reported lower satisfaction in two of the five satisfaction measures.

Of the two general work satisfaction measures, only job satisfaction was lower in more virtual teams. We found no effects of level of virtuality on resigned attitude. Although we have to interpret this result carefully since the inspection of the resigned attitude scale revealed a low alpha level, this result could be interpreted in the sense that members of virtual teams did not lower but maintain their aspiration level, but were less satisfied when working more virtually.

We found no effects of level of virtuality on task satisfaction. For the real-world teams of our sample, this is in accordance with earlier findings. When computer-mediated teams had time to adapt to the communication media, no differences in the performance level between face-to-face and computer-mediated teams were found (Hollingshead, 2001; Hollingshead & McGrath, 1995). Similarly, when time is plentiful, we could expect that they managed positive

interpersonal relationships (Walther, 2002). However, our findings do not support this expectation. Respondents of more virtual teams were less satisfied with the working relationships in their team. Finally, there was no effect of level of virtuality on satisfaction with computer-mediated communication.

Both dimensions of virtuality had effects on member satisfaction. Again, job satisfaction and team satisfaction were lower, when more team members were geographically dispersed and when they communicated more by e-mail and less face-to-face. Both dimensions of level of virtuality were negatively related to job and team satisfaction, but geographical dispersion had the stronger effects than the communication media. Thus, when looking for causal relationships between level of virtuality and satisfaction, this could give some evidence that lower satisfaction levels could be the result of geographical dispersion and less face-to-face communication due to this dispersion. There seems to be less evidence that due to low satisfaction with working relationships, people communicated less face-to-face and more computer-mediated.

How strong are the effects of level of virtuality on job satisfaction? Only four percent of all variance in job satisfaction was explained by team virtuality. When context measures were also entered into the equation, only additional two percent of job satisfaction and team satisfaction were explained by level of virtuality. Thus, although we found effects of level of virtuality on member satisfaction, these effects were small.

The context measures we included in our analyses can give us some cues how to improve satisfaction in virtual teams. Two measures seem to be especially important, trust in team mates and information management. Trust is based on individual antecedents, ability, integrity and benevolence (Jarvenpaa et al., 1998) and may therefore be less accessible by direct managerial interventions. However, efficient communication and coordination processes, continuous support of team awareness, and information about individual working situations of team members (Hertel et al., 2005) could support trust building. Efficient information management had a strong effect on member satisfaction and could be improved by the management. Since virtual team members quite often consulted the intranet, we might assume that the information provided on the intranet is crucial for the respondents and that its quality has an influence on member satisfaction. Direct management support for technology use had less influence on member satisfaction. It only influenced satisfaction with the aspect it directly aims at, satisfaction with computer-mediated communication. The same was true with attitudes towards electronic media: a positive stance towards computer-mediated communication only enhanced satisfaction with computer-mediated communication. Finally, team autonomy and task interdependence did not have much influence on member satisfaction. Hertel and colleagues (2005; 2004) argued that task interdependence might increase team cohesion and trust in virtual teams, due to more coordination requirements and thus more communication among team members. On the other hand, more coordination requirements may increase process losses and conflicts. These authors therefore proposed that task interdependence may be more positively related to performance in the beginning of

teamwork than later on. If we adopt this argumentation for member's satisfaction, task interdependence may have fewer effects in the mature teams of our study. Our results would support this argumentation; however, more research is wanted here.

Limitations

These results are based on self-reports of members of virtual teams in organizations. This allowed us to include members from a wide variety of teams and organizations, but at the same time our results may be inflated due to common source bias. The generalization of our findings may also be limited by the small and potentially biased sample. Only team members that were generally interested in virtual work may have responded to our virtual questionnaire. Another limitation of our study is the fact, that we only have information from single team members, not from whole teams. Finally, our data is cross-sectional; our interpretation of causal effects of level of virtuality on satisfaction must be considered as preliminary. We can not reject an interpretation that would propose that people who are not satisfied with the interpersonal relationships in their teams choose to communicate more via email and avoid face-to-face communication. Thus, our findings should be regarded as preliminary but promising.

Conclusion

We contribute to the ongoing discussion on how the level of virtuality of teams can be assessed. This is important since real-world teams in organizations hardly ever are pure traditional, with only face-to-face communication, nor pure virtual, with no face-to-face communication, but fall into the large category of hybrid teams (Griffith et al., 2003). Our findings support this notion. We also contribute to the discussion of potential antecedents of virtuality (Kirkman & Mathieu, 2005). Our results support the notion that on the one hand media choice may be influenced by geographical dispersion, but that on the other hand also co-located teams often communicate computer-mediated. Finally, our results add to the growing but still sparse insights on satisfaction in virtual teams in organizations. We found that especially job satisfaction was rather low in our sample. More members of highly virtual teams are not satisfied with their job than members of less virtual teams. Members of highly virtual teams also are less satisfied with working relationships in their team. However, the direct effects of level of virtuality on member satisfaction are rather low. Other contextual factors, such as trust in team mates and information policies of the organization have stronger effects on satisfaction in virtual teams.

We would very much welcome further studies in teams in organizations on team virtuality and virtual team member satisfaction. Virtual teams are no longer the exception but the norm in daily work. Due to this normalization process, the analysis of factors that influence satisfaction in virtual teams becomes crucial. Given the low job satisfaction of virtual team members we found in our study, the practical implication of our results for the management of virtual teams is straightforward: organizations should support measures that improve virtual team members' satisfaction. Based on the results of our study and in accordance with other

research, organizations should support measures that allow members to develop trustful working relationships and they should follow a supportive information management policy.

Acknowledgements

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