

What does it take to be a virtual team player? The knowledge, skills, abilities, and other characteristics required in virtual teams

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ABSTRACT

Competency models are available for many aspects of work that cut across various occupations (such as leadership, teamwork, etc.). Although *virtual* teamwork has developed to a highly prevalent aspect of work, very little is known about the knowledge, skills, abilities, and other characteristics (KSAOs) required. In the current study, KSAO requirements of virtual and traditional business teams ($n = 175$ and 205 , respectively) were compared and aligned to the Great Eight competency model. Results showed that KSAOs pertaining to Leading and Deciding and to Analyzing and Interpreting were more important in virtual teams. Conversely, virtual and traditional teams did not differ in terms of broad personality (Big Five) requirements. Together, these findings contribute to deeper knowledge on selection and training in virtual teams.

Competency models can be defined as “collections of knowledge, skills, abilities, and other characteristics (KSAOs) that are needed for effective performance in the jobs in question” (Campion, et al., 2011, p. 226; cf. Mansfield, 1996; Mirabile, 1997; Schippmann et al., 2000). As such, competency models are vital cornerstones for multiple organizational decisions, including recruiting, training, promotion, compensation, and succession planning (e.g., Campion et al., 2011). Not surprising, virtually all researchers in this field agree that competency modeling is a crucial activity for work organizations (e.g., Mansfield, 1996; Morgeson, Delaney-Klinger, Mayfield, Ferrara, & Campion, 2004; Posthuma, Campion, Masimova, & Campion, 2013; Sanchez & Levine, 2012).

To date, competency models (and reports on their development) are available for both specific occupations (e.g., for project managers: Cheng, Dainty & Moore, 2005) and specific organizations (e.g., for IBM: DeViney, Sturtevant, Zadeh, Peluso, & Tambor, 2012). In addition, Bartram (2005) introduced the Great Eight competency model as a generic competency model applicable across a variety of jobs and organizations. This model acknowledges that several tasks, such as leading and supervising others or working on a team, are highly prevalent in a variety of jobs and organizations, and should thus be incorporated in most competency models (for leadership and teamwork competencies, see, e.g., Mumford, Zaccaro, Harding, Jacobs, & Fleishman, 2000; Stevens & Campion, 1994).

In light of an ongoing globalization and digitalization of work processes, collaborating with others across a distance on virtual teams has become a new, highly prevalent aspect of work in many organizations and across a variety of occupations. Perry (2008), for instance, stated that in 2008 up to 80% of companies with more than 10,000 employees considered or employed digital forms of collaboration. Similarly, the Society of Human Resource Management (2012) reported that 46% of human resource professionals from global organizations used some form of virtual teamwork. Thus, identifying KSAOs that are needed for effective performance in virtual teamwork is of core interest

for HR professionals around the globe when selecting and developing members of such teams. Also, from a scientific perspective, gaining a deeper understanding as to which KSAOs are relevant in virtual teams specifically—as opposed to traditional teamwork KSAOs—is not only of importance for research on personnel selection and training, work design, organizational health, and (digital) leadership but may also contribute to a more thorough examination of specific dynamics and processes within digitized collaboration. Yet, broad KSAO taxonomies that may serve as competency models for virtual teamwork are currently not available.

In the current study, we identify KSAOs that are *particularly* relevant in virtual teams—meaning that such KSAOs are more relevant for individual team members' and the team's success in virtual than in traditional teamwork. For this purpose, we asked experienced members of either virtual or traditional teams to assess the relevance of KSAOs for their type of teamwork. In contrast to prior research that developed taxonomies based on empirical data (e.g., Lee-Kelley & Sankey, 2008), we deliberately followed a theory-driven top-down approach. The included KSAOs were organized along the generic Great Eight competency model (Bartram, 2005). Thus, this study is the first to develop a broad competency model for virtual teamwork by (a) considering a large set of theoretically derived KSAOs and (b) comparing assessments of their relevance across two types of teamwork (virtual vs. traditional). Thereby, this research contributes to advancing recruitment, selection, and training of members of virtual teams. Furthermore, management and design of virtual teamwork may incorporate the hereinafter reported results (e.g., by implementing processes or technologies to alleviate the challenges imposed on individual team members).

In the remainder of this introduction, we first define virtual teamwork and outline its benefits and challenges. Second, we briefly review empirical evidence on the relevance of KSAOs in virtual teamwork. Third, we present hypotheses as to which clusters of the Great Eight competency model may be more relevant in virtual as compared to traditional teamwork.

Virtual teamwork

Although virtual teams may differ considerably from each other (e.g., Bell & Kozlowski, 2002), there is some shared understanding among researchers of what constitutes a virtual team (Martins, Gilson, & Maynard, 2004). That is, teams that predominantly use digital media to communicate and coordinate their work with at least one of the team members working at a different location and/or in a different time zone are commonly referred to as virtual teams (cf. Hertel, Geister, & Konradt, 2005). On the contrary, traditional teams mostly work together in close physical proximity and frequently coordinate their work in face-to-face meetings (and are thus also referred to as face-to-face teams).

Organizations may benefit from employing virtual teamwork in many ways (e.g., Bergiel, Bergiel, & Balsmeier, 2008). First, experts from all over the world may mutually work on the same project without physically being at the same location. Second, virtual teamwork enables organizations to cut their travel budgets. Third, new knowledge may be acquired and implemented more quickly as team members are accumulating insights from many business areas or markets (cf. Siebdracht, Hoegl, & Ernst, 2009). Fourth, virtual teams have the potential to bring together multiple perspectives and thus may facilitate innovation (e.g., Townsend, DeMarie, & Hendrickson, 1998). Finally, organizations can react more quickly to changing business demands and adjust virtual teams accordingly.

However, organizations are also facing several challenges when implementing virtual teamwork. To make virtual collaboration effective, organizations must design efficient workflows that also function across distributed locations. Furthermore, performance needs to be monitored via digital media and, if necessary, employees need to be motivated and guided without or with only little face-to-face communication (e.g., Hertel, Konradt, & Orlikowski, 2004). In addition, maintaining high team spirit and trust may be difficult in geographically dispersed and often culturally diverse teams (cf. Ebrahim, Ahmed, & Taha, 2009; Furst, Reeves, Rosen, & Blackburn, 2004). Finally, communication and collaboration via digital media entails challenges, including effective use of technology

to convey information, communicating across different time zones, and developing a sense of belonging while being geographically dispersed (e.g., Driskell, Radtke, & Salas, 2003; Jarvenpaa & Leidner, 1998; Montoya-Weiss, Massey, & Song, 2001). Although these challenges have clear implications for KSAO requirements, systematic empirical studies that qualify as competency modeling are sparse (e.g., Hertel, Konradt, & Voss, 2006; Spitzberg, 2006).

KSAOs required in virtual teamwork

The literature on virtual teams includes several theoretical approaches that might be a good starting point for deriving KSAO requirements. Such approaches either theoretically elaborate on virtual teamwork requirements as their main focus (e.g., Shin, 2004) or indirectly derive requirements by drawing conclusions on the basis of other, not requirement-related results (e.g., Dennis, Fuller, & Valacich, 2008). Generally, this work has put forward manifold individual qualities as potentially relevant in virtual teamwork, including self-management skills, proactivity, communication skills, intercultural skills, willingness to trust, trustworthiness, and (electronic) media literacy (e.g., Blackburn, Furst, & Rosen, 2003; Shin, 2004; Spitzberg, 2006).¹

On the empirical side, case studies and critical incident approaches are available, which suggest KSAO requirements of virtual teams. For example, Lee-Kelley and Sankey (2008) analyzed projects of virtual teams in a global banking corporation. By comparing efficient with poor behavior in critical teamwork situations, these authors derived underlying competencies for successful behavior in virtual teams, such as personal project management competencies, appropriate use of technology and networking, willingness for self-management, and cultural and interpersonal awareness. The limitation of case studies and critical incident approaches, however, is their narrow focus on particular settings, which restricts their generalizability. Nevertheless, case studies may serve as a good starting point for generating hypotheses and for integrative models on virtual teamwork competencies, which may subsequently be tested in larger empirical studies.

As an example of such a larger empirical study, Hertel et al. (2006) tested a set of KSAOs related to telecooperation (i.e., persistence, willingness to learn, creativity, independence, interpersonal trust, and intercultural skills) in a field study with existing virtual teams. Their findings showed that, on the team level, creativity and independence indeed contributed to the prediction of team performance. Cogliser, Gardner, Gavin, and Broberg (2012) asked undergraduate students to work in virtual teams on a fictitious management project and found that team performance was mainly predicted by computer self-efficacy. Focusing on interpersonal skills in computer-mediated communication Spitzberg and Cupach (2002) identified a large set of interpersonal KSAOs (e.g., displaying assertiveness, topic management). In general, the aforementioned studies have initially shown that virtual teamwork is affected by various KSAOs of the team members. Across different studies, however, results are rather heterogeneous as to which specific KSAOs are predictive of virtual team performance.

Summarizing the current theoretical and empirical work on virtual teamwork requirements, we conclude that a diverse picture of potentially relevant KSAOs exists. Corroborating this conclusion, Krumm and Hertel (2013) counted around 60 different individual qualities that were proposed as predictors of virtual teamwork. One reason for this diversity might be that a common theoretical basis for KSAOs (such as the five-factor model for personality dispositions; Costa & McCrae, 1988) has not yet been developed in the field of virtual teamwork. Thus, an initial step in generating a KSAO model for virtual teamwork may be that researchers align their particular KSAOs to a broader framework.

In the current study, we adopt the Great Eight competency model introduced by Bartram (2005) as such a broader framework. The model includes eight broad criterion domains (see

¹Please note that we herein refer to team member characteristics only. For research on leadership of virtual teams, see, for example, Hill, Kang, and Seo (2014).

Table 1) and is seen as a generic competency model. Aligning virtual teamwork KSAOs to the generic Great Eight competency model embeds our approach into a more general framework, which may facilitate the exhaustiveness and generalizability of the retrieved KSAOs for several forms of virtual teamwork.

As another extension of previous research, we seek to provide initial support for the uniqueness of the identified KSAOs for virtual teamwork. That is, most existing studies showed that performance in or of virtual teams is predicted by certain subsets of KSAOs. However, these studies did not explore whether these KSAOs are also *more* relevant in virtual than in traditional teams or just of similar importance. It seems plausible that virtual and traditional teamwork share substantial common requirements. For instance, Hertel et al. (2006) found that some well-established traditional teamwork KSAOs (i.e., cooperative attitudes, communication skills) were good predictors of performance in virtual teams as well. Thus, study designs are desirable that compare the relevance of KSAOs for performance in virtual versus traditional teams in order to provide insights on the uniqueness of KSAOs for virtual teamwork. Consequently, our hypotheses do not only make reference to a broader framework of KSAOs but also compare their relevance in virtual versus traditional teams.

Hypotheses on global differences

The KSAOs included in the current study (see Table 1) have been selected according to their theoretical relevance for virtual teamwork (see also Krumm & Hertel, 2013). Hence, our obvious first presumption is that, globally, such KSAOs will be more important in virtual than in traditional teams. In other words, we predict that virtual and traditional teamwork generally differs in terms of required competencies, thereby justifying subsequent, more detailed analyses.

Table 1. Great Eight competency framework and sample items.

Great Eight domain	Description ^a	Sample items as included in the current study ("for the success/collaboration of my team it is important to ...")
Leading and Deciding	Initiates action, takes responsibility, sets goals, works autonomously	... set clear goals for team members. ... work autonomously. ... act on own initiative.
Supporting and Cooperating	Supports others, puts people first, acts with integrity	... share relevant information and resources. ... display willingness to cooperate. ... listen to colleagues actively and nonjudgmentally.
Interacting and Presenting	Communicates and networks effectively, successfully persuades and influences others	... resolve conflicts effectively. ... maintain one's social and business networks. ... present topics illustratively.
Analyzing and Interpreting	Clear analytical thinking, quickly takes on new technology, communicates well in writing	... communicate in writing understandably and in a structured way. ... use communication media effectively. ... work effectively with computers and digital media.
Creating and Conceptualizing	Openness to new ideas and experience, seeks learning opportunities, drives change	... promote change and innovation. ... show creativity. ... approach problems strategically.
Organizing and Executing	Works thoroughly, plans ahead, follows instructions and procedures	... set oneself goals. ... manage one's time effectively. ... clearly organize one's tasks.
Adapting and Coping	Adapts and responds well to change, manages pressure effectively	... flexibly adapt to different circumstances. ... constructively deal with criticism. ... deal with unclear and conflicting situations.
Enterprising and Performing	Focuses on achieving work objectives, seeks career advancement	... motivate oneself through performance and goals. ... work with enthusiasm and energy. ... keep track of the organizational goals.

Note. Great Eight taxonomy adapted from Bartram (2005, p. 1187).

^aDescription adapted to fit the virtual team context.

H1: Virtual and traditional teams will generally differ in terms of required KSAOs—the considered KSAOs will be more important in virtual as compared to traditional teams.

Hypotheses on specific KSAO domains

Although *all* the single KSAOs included were selected due to their theoretical relevance for virtual teamwork, overall differences in KSAO requirements may be particularly driven by some of the domains in the Great Eight competency model, which served as an organizing framework for the KSAOs included. Next we derive hypotheses for those domains that—according to previous theorizing and empirical evidence—should be particularly relevant in virtual teams.

Virtual teamwork is often characterized by asynchronous and cue-deprived communication, as well as difficulties in coordinating tasks among distributed team members. Under work conditions that are more ambiguous than in traditional team settings, team members have to actively acquire relevant information, work independently from each other, and proactively seek solutions for unclear tasks and responsibilities. Thus, taking responsibility, working autonomously (Hertel et al., 2006), and demonstrating personal initiative (Siebdrath et al., 2009) should be more important in virtual than in traditional teams. This is further strengthened by studies on leadership in virtual teams, which indicate that team members who strongly exhibit leadership behaviors tend to show higher team performance (e.g., Carte, Chidambaram, & Becker, 2006; cf. Bell & Kozlowski, 2002). Therefore, we expect the following:

H2: KSAOs mapping onto the domain Leading and Deciding will be more important in virtual teams than in traditional teams.

Members of virtual teams must frequently rely on digital communication media to communicate with their fellow members. Thus, media literacy should be a crucial skill in virtual teams because skills related to communicating with written material allow to precisely convey information to team members when synchronous face-to-face interaction is not possible. Indeed, several studies provided support for the notion that computer and media literacy is essential for members of virtual teams (cf. Rice, 1992; Trevino, Lengel, & Daft, 1987). Furthermore, virtual teams often communicate asynchronously (e.g., via e-mail or data exchange systems). A main drawback of such forms of communication is that immediate feedback and instant resolving of ambiguities is not possible (e.g., Dennis et al., 2008). As a result, team members depend on making sense out of the available information themselves, hence stressing reasoning ability as specific requirement of virtual teamwork. Albeit reasoning ability and, more globally, general mental ability has been found to predict work performance in almost any domain (e.g., Schmidt & Hunter, 1998), one may argue that communication ambiguities in virtual teams further amplify the relevance of general mental ability. Communicating in writing, analyzing, resolving ambiguities, and reasoning map onto the Great Eight dimension of Analyzing and Interpreting (Bartram, 2005). Consequently, we predict the following:

H3: KSAOs mapping onto the domain Analyzing and Interpreting will be more important in virtual teams than in traditional teams.

Members of virtual teams usually work under lower social control than members of traditional teams given the higher distance of other team members. Thus, social pressure to, for instance, start work early, work late hours, or take on additional tasks should be low. As a consequence, members of virtual teams need high levels of conscientiousness that prevent them from exploiting their autonomy. Moreover, members of virtual teams also need to organize their work by themselves. Hence, self-management skills are needed to manage their work autonomously (Harvey, Novicevic, & Garrison, 2004; Hertel et al., 2006). In line with this reasoning, Krumm, Terwiel, and Hertel (2013)

found that members of virtual teams considered working conscientiously as more important than members of traditional teams did. Working thoroughly, managing and assuring quality, and conscientiousness map onto the Great Eight domain of Organizing and Executing (Bartram, 2005). Thus we predict the following:

H4: KSAOs mapping onto the domain Organizing and Executing will be more important in virtual teams than in traditional teams.

Although increasingly prevalent, virtual teamwork can still be considered an innovation because perpetually new communication media are developed and collaboration has to be constantly adapted to changing environments. Therefore, members of a virtual team should support change and new technology and be able to quickly interpret and process information in order to adapt to technical innovations. Consequently, successfully working in a virtual team has been shown to require flexibility and creativity (Hertel et al., 2006) to deal with new and unexpected situations. Likewise, MacDonnell, O'Neill, Kline, and Hambley (2009) found that openness to experience is positively correlated with team cohesion in virtual teams and negatively with cohesion in traditional teams. Moreover, Hertel et al. (2006) found that strict adherence to rules can hinder performance in virtual teams. These authors argue that virtual teamwork often requires ad hoc problem solving, acquiring new information, and flexible adjustment to new situations and thus may not be well suited for individuals who stick too strongly to rules and procedures. Acquiring new information, innovating, and driving change map onto the Great Eight domain of Creating and Conceptualizing (cf. Bartram, 2005). Thus, we hypothesize the following:

H5: KSAOs mapping onto the domain Creating and Conceptualizing will be more important in virtual teams than in traditional teams.

Previous research is less consistent concerning the relevance of the remaining four Great Eight domains. For instance, many researchers have argued that mutual support, cooperation, and high trust among team members are particularly important in virtual teams (e.g., Jarvenpaa & Leidner, 1998; Montoya-Weiss et al., 2001), thus rendering Supporting and Cooperating a potential requirement in virtual teamwork. However, one of the advantages of electronic collaboration is that processes are often automatically documented, which in turn might decrease the need for trust (cf. Breuer, Hüffmeier, & Hertel, in press). For instance, e-mail communication in virtual teams can easily be stored and revisited when misunderstandings or conflicts occur. Therefore, trust might sometimes be even *less* important in virtual than in traditional teams. This is corroborated by findings that trust was a predictor of performance neither in virtual business teams (Hertel et al., 2004) nor in virtual (Open Source) software development teams (Hertel, Niedner, & Herrmann, 2003).

Likewise, inconsistent evidence exists for the domain of Interacting and Presenting. Although some authors attest that conflicts, as examples of drivers for requirements in the Interacting and Presenting domain, are more prevalent in virtual as compared with traditional teams (e.g., Mannix, Griffith, & Neale, 2002), other authors do not report a higher prevalence of conflicts (Mortensen & Hinds, 2001). Also, although facing the need to adapt to and cope with changing circumstances (e.g., Haywood, 1998), these requirements may be buffered by advantages such as flexible work hours and reduced travel times. Finally, although some studies emphasized the importance of persistence and motivation in virtual teams (as part of the Enterprising and Performing domain; e.g., Duarte & Snyder, 2001; Warkentin, Sayeed, & Hightower, 1997), a more recent study did not provide such evidence (Hertel et al., 2006).

Material and methods

Participants

Four hundred thirty-eight professionals with expertise in either traditional or virtual teamwork participated in this study. They were recruited through social networks or human resource representatives who distributed the link in their organization. Participants received a brief summary of the overall results of this study as an incentive to participate in the study. After excluding participants with inconsistent data or unrealistic processing times during completion of the online survey, our final sample consisted of 380 participants (M age = 41.2 years, SD = 11.5). There were 139 women (36.6%) and 241 men (63.4%). Participants were experts either in virtual teamwork (n = 175, 46.1%) or in traditional teamwork (n = 205, 53.9%), as evidenced by currently being a member of either type of team and an average experience in their form of teamwork of 9 (members of virtual teams) and 15 years (members of traditional teams), respectively (SD s = 5.16 and 5.91, respectively). Distributing links to surveys across many social media and personal contacts of several recruiters maximized the chance that each expert came from a different team (as also suggested by demographics of the teams in our data set), which enabled us to gather independent and unclustered data.

Procedure

At the beginning of the survey, participants were asked to indicate whether they had expertise in virtual or traditional teamwork. Participants then filled out several questionnaires with respect to their type of teamwork only (traditional or virtual, respectively). Biographical data were collected at the end of the survey.

Measures

KSAOs

A questionnaire gauging job requirements was developed for this study. First, items pertaining to KSAOs that are potentially relevant in virtual teams were created through an extensive search in the virtual team literature, resulting in 60 potentially relevant virtual teamwork KSAOs (for examples, see Table 1; the full list of KSAOs (see Table 4) references linking these KSAOs to the virtual team literature are available upon request from the first author). Next, to structure these items, two independent raters categorized these items based on the Great Eight competency model domains. The initial level of rater agreement was satisfying (Cohen's κ = .73). After their initial categorization, the two raters were informed about the items on which they disagreed and were asked to reach a mutual solution. In the final questionnaire, each domain was built by four to 11 items. Each item was phrased as follows: "For the success/collaboration in my traditional [in the other group, *traditional* was replaced by *virtual*] team, it is absolutely necessary to ..." (format adapted from Loughry, Ohland, & Moore, 2007). Participants indicated their agreement with each statement on a 7-point Likert scale ranging from *totally disagree* to *totally agree*. The questionnaire was developed to capture the relevance of the Great Eight competency model domains and contained several behavioral statements addressing the KSAOs included. Please note that the current study focused on describing aspects of different types of teamwork (i.e., virtual and traditional teamwork). Thus, individuals did *not* rate their own KSAOs but rather *how important* these KSAOs are for their type of teamwork (according to their experience). Participants were asked to rate the importance of the behavior described in those items for the successful functioning of their virtual/traditional team. Thus, similar to subjective self-reports of own competencies, participants gave subjective reports of their own jobs (in terms of requirements aligned to the Great Eight competency model).

Dimensions of virtuality

Albeit we have treated virtual and traditional teams as dichotomous entities in the preceding sections, most scholars agree that virtual and traditional teams may be distinguished on several dimensions of virtuality (e.g., Bell & Kozlowski, 2002; Griffith & Neale, 2001; Hertel et al., 2005). For instance, although some virtual teams may be characterized by frequent use of electronic communication media providing little contextual cues, other virtual teams are challenged mostly through the need to coordinate across different time zones. We would refer to both teams as virtual teams but obviously their specific virtuality-related challenges differ. It is easy to see that these different challenges may require different skills from team members. Thus, we included the following dimensions as potential underlying contingencies of KSAO requirements in virtual teams: extent of reliance on virtual tools, informational value of the used communication media, synchronicity of communication, and physical distance (Hoegl & Proserpio, 2004; Kiesler & Cummings, 2002; Kirkman & Mathieu, 2005).

To gauge the extent of reliance on virtual tools, we asked participants to indicate how often they usually use certain communication media (phone, phone conference, video conference, e-mail, and online data platform) to interact with their team members during a typical month. We calculated the extent of communication media use as the sum of the reported frequencies, ranging from 1 (*never*) to 7 (*multiple times a day*; cf. Chudoba, Wynn, Lu, & Watson-Manheim, 2005). To calculate the information value of the media used, we followed an approach by Newberry (2001). First, we assigned a value of media richness to each medium. Then, we added the media richness sum weighted with the frequency of media use for each participant. We operationalized the extent of asynchronous communication as the mean frequency score of highly asynchronous media (e-mail and online data platform; see media synchronicity theory, Dennis et al., 2008). In addition, we assessed the physical distance between the team members. Therefore, participants were asked to indicate how many of their team members were located at the same floor, at another floor of the same building, at another building at the same location, at another location in the same country, and in another country. Scores were obtained by first multiplying the number of team members in each category with a distance score, from 1 (*at the same floor*) to 5 (*in another country*), and dividing this score by the total number of team members.

Big Five personality traits

To rule out the alternative explanation that different KSAO requirements in virtual and traditional teams may simply reflect differences in underlying personality trait requirements (i.e., Big Five personality dimensions; Costa & McCrae, 1988), we also assessed the importance of personality traits across the two types of teamwork. To assess the importance of Big Five personality traits in virtual and traditional teams (as an alternative of the KSAO-based approach), we administered an adapted version of a Big Five Inventory (BFI-10; Rammstedt & John, 2005), consisting of two items per each Big Five dimension. We rephrased the item stems to be able to assess the importance of each trait for effective functioning of a team. That is, instead of “I” (followed, e.g., by “am outgoing and gregarious”), we asked, “For the success/collaboration in my (traditional/virtual) team, it is absolutely necessary to ...” (in this example again followed by “be outgoing and gregarious”). So, again, individuals did *not* rate their own personality traits but rather *how important* the Big Five traits are generally for their type of teamwork (according to their experience). Participants responded on the same 7-point Likert scale that was used for the Great Eight competency items. The BFI-10 has been shown to provide a reliable and valid assessment of the Big Five personality dimensions (Rammstedt & John, 2005).

Control variables

Finally, we captured biographic data by asking participants to indicate their gender, age, tenure, experience with the team, industry, and Holland’s (1985) general occupational themes. If any of

those variables differed between traditional and virtual teams, they were entered as covariates in subsequent analyses.

Analyses and results

Preliminary analyses

We conducted several independent t tests to investigate whether members of virtual and traditional teams differed substantially in biographic variables that may distort subsequent analyses. Results showed that both types of team members did not differ in experience with their current team, $t(247) = 0.21$, $p = .835$. Also, anticipated future tenure of their current team did not differ, $t(104) = -0.50$, $p = .618$, indicating that the current results do not merely reflect differences in longevity of teams. However, significant differences occurred in job experience, $t(377.46) = 4.02$, $p < .01$; organizational tenure, $t(377) = 2.77$, $p = .01$; and age, $t(376.93) = 4.04$, $p < .01$. That is, members of virtual teams indicated, on average, more job experience (18.37 vs. 13.86 years), higher organizational tenure (11.26 vs. 8.79 years), and older age (43.64 vs. 39.02 years) than members of traditional teams. Moreover, members of virtual teams were more often male than members of traditional teams, $\chi^2(1) = 8.97$, $p < .01$ (71.4% vs. 56.6%). The aforementioned variables were entered as covariates in the subsequent analyses. Please note that an additional participant was excluded because he did not report organizational tenure, resulting in a sample of 379 subjects for the subsequent analyses.

It is important that Holland's (1985) occupational themes were not equally distributed across the two types of teams, $\chi^2(5) = 18.09$, $p < .01$. While comparatively more traditional than virtual team members fell into the "social" cluster of occupations (36% and 25%, respectively), virtual as compared to traditional team members were slightly overrepresented in the "enterprising" cluster (42% and 23%, respectively). To account for the fact that this unequal distribution of occupational themes might distort results, the following main analyses were also conducted with a reduced sample in which we randomly reduced cases from overrepresented occupational themes to create an equal distribution across the two types of teamwork (reduced $n = 332$), $\chi^2(5) = 3.55$, $p = .615$.

Although some authors stress the importance of broad personality dimensions for virtual teamwork (e.g., Coglisier et al., 2012; Krumm, Terwiel, & Hertel, 2013), we maintain that their relevance has repeatedly been confirmed for traditional forms of teamwork as well (Barrick, Stewart, Neubert & Mount, 1998; Bell, 2007; Neuman & Wright, 1999; Peeters, Van Tuijl, Rutte & Reymen, 2006). Thus, their relevance should generalize across different forms of teamwork and not be specific for virtual teams. In fact, the overall analysis (multivariate analysis of variance [MANCOVA]) in the current study revealed an insignificant result indicating that virtual and traditional teams did not differ in terms of broad personality requirements, Wilks's $\lambda(5, 369) = 1.80$, $p = .113$.

Descriptive statistics and reliability estimates of the main variables are given in Table 2, bivariate correlations of Great Eight domains in Table 3. Supporting and Cooperating represented the most important KSAO domain in traditional teamwork, Analyzing and Interpreting the most important KSAO domain in virtual teamwork. Low to moderate internal consistency coefficients (Cronbach's alpha) were obtained for the Great Eight competency model domains, reflecting the heterogeneity of the KSAOs when assigned to the broader Great Eight competency framework. Bivariate correlations between Great Eight domains were all positive and moderate to high, potentially reflecting the strategy to select those KSAOs that were a priori assumed to be relevant in virtual teamwork. In fact, on average, all domains of the Great Eight competency model were considered important for both types of teamwork (average importance ratings between 5.46 and 6.02). Results of an exploratory factor analysis (principal axis factoring) further speak to this: The Kaiser criterion (eigenvalue > 1) and inspection of the Scree-Plot suggested extracting only one factor (eigenvalues = 13.08, 3.33, 2.77, 2.34, ...). Parallel analysis suggested extracting six factors; however, no meaningful pattern of loadings was observed when inspecting the six factor solution. Thus, the one-factorial solution was

Table 2. Descriptive statistics and reliability estimates of the Great Eight dimensions.

Great Eight domain	No. of Items	Traditional Team Members ^a			Virtual Team Members ^b		
		<i>M</i>	<i>SD</i>	<i>r_{tt}</i>	<i>M</i>	<i>SD</i>	<i>r_{tt}</i>
Leading and Deciding	6	5.46	0.62	.50	5.91	0.56	.47
Supporting and Cooperating	11	5.96	0.52	.74	5.77	0.61	.77
Interacting and Presenting	8	5.53	0.61	.64	5.60	0.64	.73
Analyzing and Interpreting	8	5.79	0.66	.78	6.02	0.57	.75
Creating and Conceptualizing	4	5.63	0.72	.62	5.64	0.76	.68
Organizing and Executing	10	5.80	0.48	.62	5.83	0.52	.68
Adapting and Coping	8	5.54	0.62	.60	5.51	0.67	.69
Enterprising and Performing	5	5.66	0.69	.67	5.60	0.83	.76

Note. Reliability is Cronbach's alpha. Note that in analyses on group mean differences, low reliability increases error variance, which is already accounted for by classical tests on mean differences in that significant results will become less likely (Schermedle-Engel & Werner, 2012). So, the current analyses on the mean score level may be rather conservative.

^a*n* = 205.

^b*n* = 175.

preferred. All but four items showed substantial ($> .30$) loadings on this factor. As the aim of the current study was to provide differentiated insights on virtual teamwork KSAOs in the context of a broader model (Great Eight), we accounted for the results of the factor analysis by supplementing main results on the level of Great Eight domains with follow-up analyses on the level of single items.

Differences between virtual and traditional teams

An overall analysis (MANCOVA) revealed significant overall differences between virtual and traditional teams, $F(8, 366) = 14.15$, $p < .001$, thus confirming H1 and justifying subsequent analyses on the level of single KSAO clusters. H2 to H5 were tested using ANCOVAs with type of teamwork (traditional vs. virtual) as the independent variable and each Great Eight factor as a dependent variable. Paralleling the aforementioned MANCOVA, gender, age, job experience, and organizational tenure were controlled as covariates in these analyses.

Consistent with H2, KSAOs of the Leading and Deciding domain were significantly more important for members of virtual teams than for members of traditional teams, $F(1, 373) = 44.28$, $p < .01$, partial $\eta^2 = .106$. Consistent with H3, KSAOs in the Analyzing and Interpreting domain were considered to be more important by members of virtual than traditional teams, $F(1, 373) = 8.53$, $p < .01$, partial $\eta^2 = .022$. There were no significant differences between members of virtual and traditional teams in the perceived importance of KSAOs mapping onto Organizing and Executing, $F(1, 373) = 0.54$, $p = .462$, partial $\eta^2 = .001$. The same was true for KSAOs mapping onto the domain of Creating and Conceptualizing, $F(1, 373) = 0.14$, $p = .704$, partial $\eta^2 = .000$. Thus, H4 and H5 were not supported by our data. It is important that all the just mentioned results were also confirmed in the reduced sample with equal representation of occupational themes across the two types of teamwork.

We also tested differences between virtual and traditional teams in those KSAO clusters for which we did not specify hypotheses. Of interest, KSAOs mapping onto Supporting and Cooperating were considered more important by members of traditional teams, $F(1, 373) = 9.997$, $p < .01$, partial $\eta^2 = .026$. KSAO clusters pertaining to the remaining dimensions of the Great Eight competency model yielded no significant differences between both types of team members: Interacting and Presenting, $F(1, 373) = 0.90$, $p = .344$, partial $\eta^2 = .002$; Adapting and Coping, $F(1, 373) = 0.09$, $p = .766$, partial $\eta^2 = .000$; Enterprising and Performing, $F(1, 373) = 0.50$, $p = .480$, partial $\eta^2 = .001$. Again, those results were also confirmed in the reduced sample with equal representation of occupational themes across the two types of teamwork.

Because the Great Eight competency model domains represented rather heterogeneous clusters of the herein considered KSAOs (see the low to medium internal consistencies) but were used as an organizing framework, we subsequently repeated the analyses on the level of single KSAOs. We

Table 3. Correlation of Great Eight domains.

Great Eight domain	Leading and Deciding	Supporting and Cooperating	Interacting and Presenting	Analyzing and Interpreting	Creating and Conceptualizing	Organizing and Executing	Adapting and Coping	Enterprising and Performing
Leading and Deciding	—	.47	.48	.43	.48	.53	.46	.53
Supporting and Cooperating	.40	—	.65	.58	.54	.56	.59	.52
Interacting and Presenting	.54	.58	—	.61	.51	.58	.59	.57
Analyzing and Interpreting	.42	.42	.58	—	.68	.71	.62	.63
Creating and Conceptualizing	.42	.48	.55	.59	—	.59	.65	.71
Organizing and Executing	.52	.58	.62	.56	.55	—	.65	.63
Adapting and Coping	.39	.55	.57	.39	.55	.63	—	.56
Enterprising and Performing	.41	.48	.52	.55	.63	.56	.58	—

Note. Bivariate correlations above and below the diagonal pertain to virtual and traditional teamwork, respectively. Readers interested in a full correlations matrix including all study variables are welcome to request it from the first author.

adjusted the p values using the Bonferroni method to deal with the multiple comparisons in each Great Eight domain.

Three KSAOs mapping onto the domain Leading and Deciding yielded significantly higher importance ratings in virtual as compared to traditional teams: “to act on own initiative,” $F(1,373) = 24.42$, $p < .01$, $\eta^2 = .061$; “to work autonomously,” $F(1, 373) = 77.27$, $p < .01$, $\eta^2 = .172$; and “to set clear goals for the team members,” $F(1, 373) = 15.71$, $p < .01$, $\eta^2 = .040$. From the domain of Analyzing and Interpreting, three KSAOs were rated to be more important for the success of virtual teams: “to use communication media effectively,” $F(1, 373) = 57.11$, $p < .01$, $\eta^2 = .133$; “to communicate in writing comprehensively and in a structured way,” $F(1, 373) = 8.85$, $p < .05$, $\eta^2 = .061$; and “to work effectively with computers and digital media,” $F(1, 373) = 23.15$, $p < .01$, $\eta^2 = .058$. Although there was no overall effect for the domain Interacting and Presenting, one KSAO falling in this cluster was considered more important by members of virtual teams: “to present topics illustratively,” $F(1, 373) = 8.97$, $p < .05$, $\eta^2 = .023$. Two KSAOs pertaining to Supporting and Cooperating were found to be considered more important in traditional teams: “to display willingness to cooperate,” $F(1, 373) = 11.00$, $p = .01$, $\eta^2 = .029$, and “to listen to colleagues actively and nonjudgmentally,” $F(1, 373) = 8.31$, $p < .05$, $\eta^2 = .022$. No further significant differences in importance ratings were found (for an overview, see [Table 4](#)).

Additional analyses

Working on a virtual team should be associated with higher exposure to electronic communication media, asynchronous communication, and so on. Working on a traditional team should be associated with lower exposure to such work characteristics. The underlying rationale of the analyses presented next thus is that such more fine-grained differences between virtual and traditional teams may drive differences in KSAO requirements. In an exploratory attempt to test if any of the effects that were posited by H2 to H5 were associated with level of virtuality, we conducted mediation analyses using the INDIRECT script for SPSS (Preacher & Hayes, 2008). We used 5,000 bootstrap resamples and a bias corrected confidence interval of 90% in the analyses. Separate analyses were conducted with type of teamwork as the independent variable and each one of the three Great Eight competency model domains for which we obtained significant main effects (see earlier) as the dependent variables. The following four mediators were considered: extent of electronic communication media use, information value of the used media, extent of asynchronous communication, and physical distance of team members. Again, we controlled for age, gender, job experience, and organizational tenure by adding these variables as covariates. Mediation analyses revealed that the differences between members of virtual and traditional teams in KSAOs pertaining to the domain Leading and Deciding were only mediated by the extent of digital media use (point estimate of -0.09 ; bias corrected confidence interval of -0.17 to -0.01), such that the higher use of digital media in virtual teams was associated with increased relevance of KSAOs in that particular domain. The other three mediators considered (information value of used media, level of synchronicity, and physical distance) showed no significant effects. Also, all other mediation analyses for other KSAO clusters failed to reveal bias corrected confidence intervals that did not include zero.

Discussion

The current study focused on differences in KSAO requirements as reported by members of virtual or traditional teams. Members from both types of teams assessed the importance of a broad set of KSAOs based on their work experience. The KSAOs were organized along the Great Eight competency framework (Bartram, 2005). Albeit more research is certainly needed, several inferences may be drawn on the basis of the current results.

Table 4. Analyses of covariance on the level of single KSAOs.

Great Eight domain	KSAOs	<i>F</i> value	<i>p</i> ^a	Mean Difference in Importance Ratings ^b
Leading and Deciding	to make clear decisions.	4.90	.165	0.22
	to take on responsibility.	1.97	.968	−0.10
	to motivate other team members.	0.49	1	−0.01
	to act on own initiative.	24.42	.000	0.59
	to work autonomously.	77.27	.000	1.45
	to set clear goals for other team members.	15.71	.001	0.58
Supporting and Cooperating	to share relevant information and resources.	.16	1	0.00
	to display willingness to cooperate.	11.00	.011	−0.31
	to show willingness to help others.	7.72	.063	−0.33
	to show integrity and loyalty.	1.93	1	−0.11
	to adapt to others and the team.	1.10	1	−0.15
	to promote cooperation among team members.	1.77	1	−0.12
	to ray out credibility.	0.40	1	−0.03
	to communicate beyond professional issues.	4.99	.287	−0.38
	to promote trust among team members.	3.00	.923	−0.14
	to prevent feelings of isolation through social communication.	4.25	.439	−0.24
	to listen to colleagues actively and nonjudgmentally.	8.31	.046	−0.23
Interacting and Presenting	to verbally communicate in a clear and structured way.	0.87	1	0.09
	to present topics illustratively.	8.97	.023	0.33
	to pick up conflicts.	0.47	1	0.10
	to solve conflicts effectively.	0.99	1	−0.13
	to foster social and private networks.	0.01	1	0.01
	to convince team members.	0.05	1	0.08
	to present oneself confidently.	0.88	1	−0.14
	to present oneself positively.	2.67	.823	0.23
Analyzing and Interpreting	to use communication media effectively. ^c	57.11	.000	0.93
	to communicate in writing understandably and in a structured way.	8.85	.025	0.29
	to work in a solution-oriented way.	0.07	1	0.01
	to analyze data effectively.	1.39	1	−0.08
	to effectively learn to use new technologies. ^c	2.00	1	0.24
	to gain an understanding of others' tasks.	2.57	.879	−0.13
	to work effectively with computers and digital media. ^c	23.15	.000	0.56
	to show analytical skills.	0.20	1	0.02
Creating and Conceptualizing	to quickly pick up and use information.	4.15	.170	0.24
	to promote change and innovation.	0.03	1	0.09
	to show creativity.	2.75	.393	−0.14
	to approach problems strategically.	2.172	.566	−0.16
Organizing and Executing	to work on many things at the same time.	0.62	1	0.05
	to set own goals.	1.48	1	0.12
	to manage one's own time effectively.	0.11	1	−0.04
	to structure own tasks clearly.	5.36	.212	0.19
	to work systematically and in a structured way.	2.05	1	0.14
	to finish tasks reliably.	0.39	1	−0.03
	to adhere to orders.	0.94	1	0.06
	to monitor quality and progress of one's tasks.	4.52	.342	0.22
	to coordinate one's tasks with others.	1.18	1	−0.10
	to improvise in difficult situations.	6.23	.130	−0.31
Adapting and Coping	to adjust to different circumstances flexibly.	0.00	1	0.00
	to use knowledge about other cultures.	0.05	1	0.00
	to show openness to other cultures.	0.47	1	−0.07
	to handle criticism constructively.	2.82	.752	−0.17
	to deal with ambiguous situations.	0.22	1	−0.01
	to work under pressure.	2.29	1	0.18

(Continued)

Table 4. (Continued).

Great Eight domain	KSAOs	<i>F</i> value	<i>p</i> ^a	Mean Difference in Importance Ratings ^b
Enterprising and Performing	to work motivatedly even when facing failure.	4.37	.298	−0.22
	to cope with many stressors.	0.05	1	0.02
	to motivate oneself through achievement and goals.	1.33	1	−0.13
	to work enthusiastically and energetically.	0.64	1	−0.09
	to keep track of corporate goals.	2.53	.563	−0.21
	to take care of one's own development.	0.01	1	−0.02
	to autonomously increase one's knowledge.	0.91	1	0.13

Note. KSAOs = knowledge, skills, abilities, and other characteristics.

^aBonferroni-adjusted for the multiple comparisons within each Great Eight domain; that is, we multiplied the exact *p* value by the number of tests in each domain and inspected if the new *p* value exceeded the conventional threshold of *p* < .05. ^bPositive values indicate higher importance ratings by virtual team members. ^cAssignment of technology related skills to the domain Analyzing and Interpreting was conducted in line with Bartram (2005, p. 1203).

First and foremost, competency modeling for virtual teamwork settings is worth the effort. Although, by and large, KSAOs from all the Great Eight competency model domains were considered highly relevant for both virtual and traditional teamwork, still some KSAO domains were considered even more relevant in virtual as compared to traditional teams. This may sound trivial, especially when considering the multiple challenges of virtual teamwork (e.g., Furst et al., 2004; Kirkman & Mathieu, 2005). However, quite a few studies provided results suggesting that the KSAOs needed in virtual teams may be quite similar to those required in traditional teams (Rice, 1992; Siebdrath et al., 2009). Hence, the current results further add to the notion that teamwork in a digital environment may pose specific challenges and, therefore, require different strategies in selecting and developing team members.

Second, the focus of future competency models may be on the domains of Leading and Deciding as well as Analyzing and Interpreting. In line with our theorizing, KSAOs addressing initiative, autonomy, and goal setting (i.e., KSAOs driving virtual teamwork requirements in the domain of Leading and Deciding), as well as communicating in writing, analyzing, and effectively using digital media (i.e., KSAOs driving virtual teamwork requirements in the domain of Analyzing and Interpreting) were found to be more important in virtual teams. These results extend previous studies that provided similar findings but did not empirically contrast virtual and traditional teams (e.g., Hertel et al., 2006; Hwang, 2011; Trevino et al., 1987). Although applying a more conservative test of the relevance of KSAOs, the current findings are well in line and thus further strengthen insights from research on computer-mediated communication (e.g., Spitzberg, 2006), as well as from research on leadership in virtual teams (Carte, Chidambaram, & Becker, 2006; cf. Bell & Kozlowski, 2002).

Third, differences between virtual and traditional teams in terms of KSAO requirements were partly contingent on more detailed, virtuality-related work conditions. Results of a mediation analysis suggest that the difference between virtual and traditional teams with respect to Leading and Deciding KSAOs was contingent on differences in the extent of digital media use. Indeed, virtual teamwork is often characterized by (or a consequence of) distributed collaboration, leading to more isolated work environments (Kirkman, Rosen, Gibson, Tesluk, & McPherson, 1995) and reduced influence of social norms (Moser & Axtell, 2013). These conditions should in fact require more autonomous decision making, proactive information seeking, and initiating actions (cf. Hertel et al., 2006). This initial finding calls for more fine-grained analyses acknowledging that the label “virtual teams” may comprise a rather heterogeneous set of work teams and that KSAO requirements may be understood only if the specific form of digital collaboration is taken into account (cf. Kirkman & Mathieu, 2005). Several theories have outlined the impact of media characteristics on aspects of team member collaboration (e.g., media synchronicity theory, Dennis et al., 2008; social information-processing theory, Walther, 2011) and may provide a fruitful basis for further explanatory factors of

KSAO differences between virtual and traditional teams. Generally, extending our knowledge as to when and why virtual teamwork competencies are relevant is essential to keep up with the rapid growth of virtual teams around the globe and to satisfy the increased need for targeted staffing and development of teams.

Fourth, the perceived importance of some KSAO domains did not differ between virtual and traditional teamwork. Contrary to our hypotheses, KSAOs related to Organizing and Executing and to Creating and Conceptualizing yielded similar relevance ratings in both types of teams. Notably, even results on the item level did not yield further differences between traditional and virtual teamwork. Although this seems to be in contrast to previous research (e.g., Harvey et al., 2004; Hertel et al., 2006; MacDonnell et al., 2009), one may again consider that most previous studies did not explicitly compare KSAO requirements between virtual and traditional teams. Based on the current results, we argue that getting one's work done and planning ahead (Organizing and Executing) as well as finding new solutions and acting strategically (Creating and Conceptualizing) are highly relevant qualities in any type of team, and thus not a higher requirement in virtual teams. As a notable exception from this overall finding, Krumm et al. (2013) found higher importance ratings of Organizing and Executing KSAOs in virtual teams that consisted of members from different cultures—such cross-cultural teams were underrepresented in the current study. One might thus argue that Organizing and Executing KSAOs are more relevant only in more complex forms of virtual teamwork (e.g., high cultural variety). Certainly, more research is needed addressing the KSAO contingencies of underlying characteristics of virtual teams.

Fifth, “classical” teamwork KSAOs may even be less relevant in virtual teams. In the current study, this was the case for Supporting and Cooperating KSAOs. On the one hand, members of virtual teams often face the challenge of working under higher levels of uncertainty due to, for instance, delayed communication or lack of feedback and context information about the other team partners. Many researchers have thus argued that mutual support, cooperation, and trust among team members are particularly important in virtual teams (e.g., Jarvenpaa & Leidner, 1998; Montoya-Weiss et al., 2001). On the other hand, the extent of cooperation among team members may vary depending on several factors (e.g., the reward structure; Bamberger & Levi, 2009). Virtual and traditional teams differ substantially on one particular antecedent of support and cooperation: the extent of direct personal encounters with colleagues. Several authors have argued that helping colleagues is a rather spontaneous act (e.g., Ilies, Scott, & Judge, 2006) and more likely to occur in personal contact and among individuals with good interpersonal relationships (cf. Anderson & Williams, 1996). One may further argue that one of the advantages of electronic collaboration is a higher degree of automatic process documentation (cf. Breuer, Hüffmeier & Hertel, in press). For instance, e-mail communication in virtual teams can easily be stored and revisited when misunderstandings or conflicts occur. Therefore, trust might be even *less* important in some virtual teams as compared to traditional teams. This is corroborated by findings that trust was a predictor of performance neither in virtual business teams (Hertel et al., 2004) nor in virtual (Open Source) software development teams (Hertel et al., 2003). Furthermore, social information-processing theory argues that team members can adapt to characteristics of digital media over time, leading to a similar quality of interpersonal relationships as in face-to-face interactions (cf. Walther, 2011). Together, the current finding in the domain of Supporting and Cooperating speaks to the extant theoretical arguments and empirical findings suggesting lower supporting and cooperating requirements in virtual as compared to traditional teams. Further research may pursue this line of reasoning by examining potential moderating conditions of Supporting and Cooperating requirements in virtual teams more closely.

Limitations and future research

Various limitations should be considered when interpreting the results. First, the current study used a convenience sample. Thus, team members are not representative of all types of traditional and

virtual teams. However, given that this is one of the first studies to assess a broad set of KSAOs in both types of teamwork, our initial results might stimulate subsequent research providing more detailed insights. Specifically, future research might further elaborate on challenges specific for different virtuality dimensions in order to reveal which KSAOs are required in which kind of virtual team.

Second, our results are based on subjective importance ratings from experienced team workers. Although reflecting crystalized experience of these workers, such ratings may nevertheless be biased and should be complemented by regression analytic approaches using external performance data both on the individual and on the team level (e.g., Hertel et al., 2006). One might argue that (virtual and traditional) team members may simply refer to their stereotypical conceptions of what constitutes a good (virtual or traditional) team player. We like to hold against this that our sample comprised experts with substantial experience in either form of teamwork. In addition, the fact that controlling for expertise did not change our results renders this limitation unlikely.

Third, in the absence of instruments that enable a broad assessment of potentially relevant virtual teamwork KSAOs, we relied on a selection of theoretically and/or empirically relevant KSAOs as reported in the literature. Although we used the Great Eight competency model as an organizing tool, other selections of KSAOs and other frameworks may also be plausible. In fact, the assumed eight-factorial structure was not supported by exploratory factor analysis. Rather, variance in workplace requirements was best described by a single factor. However, results on the item level provided some support for our aggregation, at least in those domains that were considered more relevant for virtual teamwork: Significant differences on the item level were overrepresented (three items each) in the domains of Leading and Deciding and Analyzing and Interpreting. Item contents like acting on own initiative, working autonomously, and setting clear goals for other team members are in fact best resembled by Leading and Deciding as specified in Bartram's Great Eight competency framework (2005, p. 1202). Likewise, to use communication media effectively, to communicate in writing understandably and in a structured way, and to work effectively with computers and digital media—while often referred to as computer self-efficacy (cf. Wang & Haggerty, 2011)—is best resembled in Bartram's (2005) taxonomy by the domain Analyzing and Interpreting, which contains a subdomain labeled “Applying Expertise and Technology.”

Although a limitation of the current approach lies in the unclear factorial validity of the eight domains, however, using a generic framework and a large set of KSAOs also provides several advantages. First and foremost, content validity of the KSAO selection is provided. Applying a set of KSAOs that covers broad KSAO domains is a necessary step in overcoming idiosyncratic KSAO selections and in connecting and generalizing findings. Second, bottom-up approaches that are concerned with establishing a factorial structure (instead of a priori assuming it) can by definition not be based on a priori formulated hypotheses and thus need to be exploratory. Third, grounding requirement analyses on established models may also stimulate continuous refinement of such models, in that new and previously underrepresented workplace conditions are incorporated. In sum, further elaborating on and adapting generic competency models to virtual teamwork may be a prevailing concern of virtual teamwork research.

Fourth, the herein reported results may be contingent on other variables not included in the current study. For instance, we did not assess team cohesion, culture, team phases, nature of team tasks (e.g., conjunctive), and so on. Future research may not only include such moderating variables but also consider other outcomes, such as team viability and team member satisfaction.

Finally, the reported mediation analyses should be treated as an exploratory add-on to our main results. All variables in the mediation analyses were assessed at the same time, and thus the included mediators cannot be interpreted as “explanatory” variables. Please note, however, that both the dependent variable and the mediating variables represented characteristics of the team and thus can be considered rather stable. Nevertheless, future research should employ such analyses in a longitudinal design.

Practical implications

Acknowledging these limitations, our results may provide initial insights for competency modeling in virtual team environments. Obviously, KSAOs that relate to Analyzing and Interpreting as well as to Leading and Deciding should play a prominent role in selecting members of virtual teams (see also Hertel et al., 2006). The current study provided items that can be easily converted into a questionnaire to assess self-reported KSAOs in these domains. Moreover, biographic and situational interview questions may be generated to capture those KSAO domains.

Furthermore, challenges in KSAOs pertaining to Analyzing and Interpreting as well as to Leading and Deciding may be considered not only in selection and assessment but also in managing virtual teams. Organizations may benefit from installing teams in ways that diminish these KSAO requirements if future team members have not yet gained relevant skills. For instance, training interventions and instructions how and when to use which communication media can be in place if team members have not gained sufficient computer skills. Also, frequent social and supervisor support may help alleviate potential problems in Leading and Deciding.

Although more research is needed on virtuality-related challenges and their effects on KSAO requirements, several KSAO domains and broad personality dimensions did not yield significant differences. Hence, the current study also suggests that one might be well advised to recruit members of virtual teams from successful members of traditional teams (e.g., Siebdrath et al., 2009). However, additional selection and development should be considered that addresses, for instance, the challenges to communicate over digital media and deal with written material (Analyzing and Interpreting), as well as to work autonomously and handle a higher degree of self-management demands (Leading and Deciding).

The differences between virtual and traditional teamwork in Leading and Deciding were contingent on the larger extent of digital media use in virtual teams. However, differences in other KSAO domains were not further qualified by any other dimension of virtuality. In the absence of detailed knowledge about *why* KSAO domains are relevant (or not) in virtual teamwork, virtual team managers may be well advised to conduct their own requirement analyses before staffing and training virtual teams.

Conclusion

The current study advanced previous approaches in identifying requirements of virtual teamwork by applying a broad set of KSAOs, by comparing data obtained from members of virtual teams with data obtained from members of traditional teams, and by assessing virtuality-related challenges as potential explanatory variables of the differences between both types of teamwork. In doing so, a differentiated picture of KSAO requirements in virtual teams could be drawn, including competency domains that turned out to be more, less, or equally relevant in virtual and traditional teams. Furthermore, underlying work conditions that drive some KSAO requirements in virtual work conditions (i.e., high extent of use of digital media) were identified. The current results may stimulate further competency modeling and subsequently improve selection and training in a growing form of collaboration.

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