Using Social Relations Analysis to Examine the Impact of Role Change on Interpersonal Perceptions in Virtual Teams

Alecia M. Santuzzi
Northern Illinois University
asantuzzi@niu.edu

Jeanette Zoeckler
SUNY Upstate Medical University
zoecklej@upstate.edu

Abstract

Virtual teams are susceptible to disruptions such as role changes. Due to inconsistent conclusions in the current literature, it is difficult to predict how role disruptions might affect interpersonal perceptions in those environments. We recommend using a social relations analysis to uncover interpersonal processes within virtual teams that might be hidden in the complex multilevel structure of teams. We demonstrate this technique using data from a study involving 40 virtual teams configured in a laboratory; half of the teams experienced a change in leader role during the collaboration. The analysis revealed significant perceiver (individual differences in rating tendencies) and relationship variance (differentiation among team members) in evaluations of team members. Teams experiencing role change showed more differentiation of partners in evaluations and accuracy in guessing how team members evaluated them, compared to teams without role changes. Implications for future research on interpersonal processes in virtual teams are discussed.

1. Introduction

With the continued advancement of technology tools, virtual teams continue to increase in popularity in social and work settings. Meta-analyses and conceptual analyses suggest that virtual teams experience less satisfaction and more social disruptions than in traditional, face-to-face teams (Baltes, Dickson, Sherman, Bauer, LaGanke, 2002 [2]; Ortiz de Guinea, Webster, & Staples, 2005 [3]). Although it is often assumed that the disruptions in virtual teams will directly and negatively affect the team's interpersonal processes, the current literature in the social and information sciences remains unclear about the connection. Much of the ambiguity can be traced back to differences across the literatures in the assumed ways that virtual team members engage in interpersonal processes and form perceptions of each other. The present study examines how interpersonal perceptions in virtual teams are affected by one of the most common disruptions--role changes within the team. Guided by an inputs-processes-outcomes (I-P-

O) framework (e.g., Hackman & Morris, 1975 [4]; Martins, Gilson, & Maynard, 2004 [5]), we applied a variance components analysis to examine how disruptions to team composition affected interpersonal processes and perceived outcome quality in virtual teams.

1.1 The Importance of interpersonal processes in collaboration

Team effectiveness is believed to be grounded in effective communication and socialization processes, which rely heavily on social perceptions among team members (Marks, Mathieu, & Zaccaro, 2001 [6]; McGrath, 1984 [7]). These social perceptions include perceptions of fellow team members and metaperceptions—perceptions of what team members think of the self (Laing, Phillipson, & Lee, 1966 [8]). Positive metaperceptions and evaluations of team members should facilitate the development of trust and cohesion—two key factors that contribute to successful teamwork during collaborations (McAllister, 1995 [9]; Kozlowski & Bell, 2003 [10]), especially for highly interdependent tasks (Alge, Wiethoff, & Klein, 2003 [11]).

Importantly, disruptions during collaboration are expected to negatively affect the team's interpersonal processes. Changes in team membership, conflicts, and changes in roles or task distribution are examples of common disruptions during team collaboration. For example, research has shown that role changes, especially in core roles within teams, have been shown to disrupt coordination within the team (Summers, Humphrey, & Ferris, 2012 [12]). According to Uncertainty Reduction Theory (URT; Berger & Calabrese, 1975 [13]), such disruptions or changes can cue ambiguity in the team's dynamics and potentially increase uncertainty within the team. Processes such as role differentiation establish what each team member understands as the boundaries for each team member's role and the associated scripts for communication with those team members. When roles change, these routines may or may not continue to apply, leaving role definitions ambiguous until the team adapts to the new state of affairs (Baard, Rench, & Kozlowski, 2014 [14]). For example, when a change

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in leadership occurs within the team, team members must adjust to relating to the former leader now as a peer and the new leader as a leader (rather than a peer). This change may lead team members to evaluate team members and their own standing within the team differently.

Teams that experience such disruptions may seek information to resolve the role ambiguity, includingming new perceptions of team members and metaperceptions of what team members think of them in the new situation. Importantly, any conflict that emerges as a function of such disruption may be masked by the complexity of team structure and dynamics (LeDoux, Gorman, and Woehr, 2012 [15]).

Note that much of the theoretical work on interpersonal processes and reactions to disruption in teams is based on evidence from face-to-face collaborations. Often it is assumed that the same social processes will generalize to computer-mediated or virtual team contexts with few exceptions. However, evidence from meta-analyses and conceptual reviews highlight large inconsistencies in the literature on virtual teams and collaborations that warrant a more thorough analysis of how interpersonal processes might work in virtual teams. If the interpersonal processes involved in virtual collaboration differ from those in face-to-face collaboration, then the impact of disruption might also be different for virtual teams.

1.2 Interpersonal processes in virtual teams

Although the specific definition of "virtual" is a continuing source of debate, research generally agrees that virtual teams involve two or more members who share a common goal and attempt to accomplish at least some part of that goal by communicating through technology (as compared to face-to-face communication; Martins et al., 2004 [5]). The broad definition allows virtual teams to vary greatly on several important features including degree of interdependence, duration of relationship, nature of communication, and specificity of goals. The present analysis uses data from a study examining disruption to virtual teams that are 1) newly developed, 2) assigned an interdependent task, and 3) rely only on synchronous technology (viz., Skype) to complete the task. These teams are comparable to project teams that are assembled on a temporary, "as needed" basis, reflecting a very common use for virtual teams (Powell, Piccoli, & Ives, 2004 [16]).

Aside from their popularity, short-term virtual teams provide an interesting avenue for study because of their high proneness to disruptions in communication and interpersonal processes. Absent of many of those social cues, computer-mediated and

virtual teams tend to struggle with the development of interpersonal factors such as social cohesion and trust (Galyon, Heaton, Best, & Williams, 2016 [17]; Olsen & Olsen, 2000 [18]). Without the immediate availability of many social cues that face-to-face teams use, the exchange of social information in virtual teams is slower than in face-to-face communication (Clark, Clark, & Crossley, 2010 [19]; Gilson et al., 2015 [200; Kiesler, Siegel, & McGuire, 1984 [21]) and might yield weaker social connections in virtual team activities.

On the other hand, some research and theory from the communication and information sciences suggests that social relationships might actually form very quickly within virtual teams (Tidwell & Walther, 2002 [22]). For example, virtual teams have been thought to rely on "swift trust" (Jarvenpaa & Leidner, 1999 [23]) by which strong bonds are assumed from the beginning of the collaboration. Having these bonds established very quickly facilitates team dynamics and effectiveness particularly for short-term project teams. To date, research has yet to directly examine whether the psychological processes involved in relationship formation are quantitatively slower or bonds among members are weaker, or if the interpersonal processes are just qualitatively different in virtual teams as compared to face-to-face contexts (Santuzzi, Budnick, & Cogburn, 2013 [24]).

In addition to potential differences in the process of forming interpersonal perceptions in virtual teams, research also has noted some differences in the valence of the perceptions in virtual as compared to face-to-face teams. Research suggests that virtual teams that experience anonymity might form more negative interpersonal perceptions of each other than those who do not experience anonymity (Rains, 2007 [25]) and report less commitment to their team members (Johnson, Bettenhausen, & Gibbons, 2009 [26]). Even before encountering environmental or other challenges to collaboration, virtual teams might already start at a somewhat negative baseline for interpersonal perceptions.

Further challenging interpersonal processes, virtual teams tend to experience a number of disruptions to team composition and social dynamics. The fact that virtual teams rely on technology to transmit information to group members introduces a higher likelihood of disruption as technology often performs below expectations or fails. Additionally, research has shown that virtual teams naturally experience more disruptions such as conflict, membership changes, and role changes within the team than face-to-face teams (Jarvenpaa & Leidner, 1999 [23]; Zaccaro, Ardison, & Orvis, 2004 [27]). Virtual teams tend to have more fluid membership

(Zaccaro et al., 2001 [27]) and tend to have less fixed leadership hierarchies, such that the leader role may rotate in turn-taking or based on calls for expertise during different phases of the task (Shuffler, Wiese, Salas, & Burke, 2010 [28]). With the many changes that virtual teams experience over the course of a project or work period, it is especially important to not only account for such changes in the work team structure but also the impact of those changes on team member perceptions and dynamics.

1.3 Impact of role change on interpersonal processes in virtual teams

Interpersonal relationships in team members may be more critical to virtual team performance than in face-to-face team performance (Breuer, Hüffmeier, & Hertel [29]). Whether the roles emerge or are assigned, team members must understand what roles each person will be playing in order to facilitate the required relationships within the team. This shared understanding of who will play what role encourages coordination during team task performance (Marks, Matthieu, & Zaccaro, 2001 [6]).

If strong bonds are critical to successful virtual teamwork, changes in team member roles during collaboration should serve as disruptions to teamwork with the potential for a negative impact on the social context. However, the expected social impact of role changes in virtual teams depends on the strength of the interpersonal connections before the disruption or change occurs. If the connections in a virtual team are weak, as suggested by some past research (e.g., Kiesler et al., 1984 [21]), then disruption should not yield a large impact; there are no bonds or clear schemas to be disrupted by change. However, if quick and strong bonds are formed very early in the team process (e.g., Tidwell & Walther, 1992 [22]), changes to the originally established roles should yield a negative impact on interpersonal perceptions among team members because it disrupts the relationship bonds that facilitate virtual team effectiveness. Due to the complex dynamics of actively collaborating teams and multilevel structure of the relationships within those teams, the impact of disruption on interpersonal processes within virtual teams is difficult to observe without sophisticated analysis techniques that can account for those factors.

1.4 Using social relations analysis to examine interpersonal processes in virtual teams

Many researchers and practitioners who facilitate virtual team activities collect data from those team members to understand their experiences within the team and associations with team outcomes. However, a methodological challenge arises when trying to uncover interpersonal processes and the impact of disruptions on those experiences. A change within the team is a team-level experience. However, the impact of change might be evident at several levels. In addition to affecting the overall team, changes may affect individual perceptions and experiences as well as specific relationships between individuals in the team. Thus, the analysis of the impact of change in virtual teams should be conducted at several levels of analysis. One step toward addressing this issue is to measure team process variables and outcomes at the appropriate level of analysis and using flexibility in common statistical techniques such as multilevel modeling to compute results.

A trickier issue that arises is that when forming interpersonal perceptions within virtual teams, each team member forms a perception (or metaperception) of each other team member. The perceptions are *round-robin* and, thus, are nested in perceivers, targets, and dyads in addition to being nested in teams. For example, in a four-person virtual team, every team member serves as a perceiver for three others, a target of three others' perceptions, and as a member of three dyads. All three of these factors potentially serve as sources of influence on the interpersonal perceptions formed in the virtual team.

A recommended approach to identifying systematic variation based on each of those sources is a *social relations analysis* (Kenny & LaVoie, 1984 [31]). The social relations analysis treats each of the sources of variance as random effects, computes the size of the variance component, and tests for whether they are statistically significant. The three main sources are Perceiver, Target, and Relationship components. *Perceiver variance* represents the extent to which evaluations are driven by a team member's general tendency to rate others in a certain way. *Target variance* reflects the extent to which a team member is rated by others a certain way. In other words, it is the extent to which others generally agree on a positive or negative evaluation of a given team member. *Relationship variance* refers to the extent to which evaluations made by a team member are unique to specific targets. Large relationship variance components suggest that team members differentiate targets.

Identifying these systematic sources of variation in interpersonal perceptions can provide a great amount of information about the social dynamics within virtual teams, information that is often hidden by analyses that are limited to mean score differences at the team level. Large perceiver variance, for

instance, suggests that team members are evaluating their partners consistently, which might be driven by individual differences in rating styles or failure to differentiate among partners.

Large target variance suggests that team members agree about how to evaluate each other. As team members gain more information about each other, we would expect consensus in evaluations to become larger. Low levels of behavioral cues and other social information may reduce the amount of consensus among team members, leading to a smaller target variance component. Virtual teams may be particularly susceptible to low levels of target variance when visible, behavioral information about team members is limited during collaboration.

Relationship variance indicates the extent to which team members are differentiating their evaluations among their team members. This indicates specific relationships or bonds are present in the team. It is important to note that these bonds may be positive or negative. In other words, a strong relationship variance component could suggest affiliation or conflict between specific team members. Recent research has focused on the relationship variance to identify conflict within teams (LeDoux et al., 2012 [15]).

The variance components also may be used to identify more complex interpersonal processes (Kenny, 1994 [1]). Two processes that have been shown to relate to team coordination are meta-accuracy and perceived reciprocity. Meta-accuracy refers to the extent to which individuals can accurately gauge how they are viewed by their team members. This accuracy can be considered at a generalized level, which indicates the extent to which individuals understand their average evaluation within the team. Accuracy can also be examined at a dyadic level, identifying the extent to which an individual can detect how she or he is evaluated by each specific team member.

Perceived reciprocity refers to the extent to which an individual gives evaluations of team members that are similar to how she or he expects to be evaluated by those team members. Reciprocity also can be examined at the generalized or dyadic level. Generalized reciprocity reflects the extent to which an individual generally gives evaluations to team members that match how that individual expects to be evaluated by team members on average. Dyadic reciprocity identifies the extent to which reciprocity occurs between two specific team members.

Some limited research has applied social relations analysis to examine the importance of role definitions in team member perceptions and experiences. Kenny and Livi (2009) conducted a social relations analysis

across seven studies and found that perceptions of leaders within teams are driven by all three sources of variance (perceiver, target, and dyad) [32]. Malloy and Janowski (1992) examined both the perceptions and metaperceptions of team members in leader roles within teams and also found that team members' perceptions of each other were driven both by team members' general rating tendencies (perceiver effect) and consensus among team members on evaluations (target effect) [33]. However, metaperceptions were driven primarily by perceiver effects; team members expected other team members to agree on their evaluations of them. Further, they found evidence that team members were generally accurate about how they thought other team members evaluated them, but they were not accurate in guessing how specific team members evaluated them.

Similar to Malloy and Janowski (1992) [33], the data collected for this analysis included perceptions and metaperceptions of short-term teams of previously unacquainted individuals. The perceptions and metaperceptions were collected in a round-robin design, by which each team member formed perceptions and metaperceptions of each other team member. Different from the above research, the data used in the present analysis were based on teams in which the leader role was assigned and, in some cases, where the assigned leader role changed. Building from past work, the present analysis aims to uncover how team member perceptions and metaperceptions might differ when the social context is disrupted by a change in leader role. We examined the impact on the sources that influence interpersonal perceptions in virtual teams (perceiver, target, and relationship). Also similar to Malloy and Janowski (1992), the accuracy of metaperceptions (i.e., meta-accuracy) when compared to team members' actual evaluations was examined for signs of disruption [33]. We examined meta-accuracy at both the generalized and dyadic levels. We expanded the analysis to also capture evidence of perceived reciprocity at generalized and dyadic levels.

1.5 Summary

The present study introduces social relations analysis as a tool to uncover the interpersonal impact of role change within virtual teams. Specifically, the analyses highlight how social disruptions within virtual teams might affect the interpersonal perceptions strategies that are evident at the team, dyad, and individual levels of analysis. We then examine the extent to which these interpersonal perception processes predict individual experiences and perceptions of team outcomes.

2. Method

Participants (52 men and 99 women) participated in teams of 3 or 4 participants on a conference call using Skype. Most of the participants were recruited from the Central New York community and received a $20 gift card as compensation. A small portion of the sample (N = 20) comprised students who received course credit in lieu of payment in exchange for participation. Due to statistical analysis requirements, only the complete groups with four embers (31 groups; N = 124) were included in the analyses.

Each participant within a team was randomly assigned to a separate room and could not see the other team members. Participants were asked to use the identity of Person A, B, C, or D, according to the assigned computer station. Person C was the initial leader in all team sessions. After orienting the team to the technology, the researcher gave the team ten minutes to propose and discuss updates to the Seven Wonders of the World. Five minutes into the conversation, half of the teams (randomly selected) were asked to change leaders from Person C to Person D.

At the end of the discussion, participants completed the 20-item Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988 [34]) to assess their emotional states at that point in the session. Participants indicated their current states on each of the 20 items (10 positive and 10 negative using a five-point response scale (1 = *very slightly or not at all* to 5 = *very much*).[1]

The team leader then led the team through a 30-minute, abbreviated murder mystery task (Stasser & Stewart, 1992 [35]). The task involved reading evidence pertaining to a fictitious murder and reaching consensus as a team about the murderer's identity.

At the conclusion of the task, each participant reported on a five-point scale (1 = *not at all*; 5 = *to a great extent*) the extent to which the team worked well together and successfully completed the task (adapted from Cooke & Lafferty, 1988 [36]). Participants rated the extent to which they were personally committed to the solution proposed by the team, thought the solution generated by the group was better than the one the respondent might have developed on his/her own, felt that the solution had been reached on a consensus basis, thought the group came up with the best possible solution given time and technology constraints, and

thought the members of the group worked together effectively.

Finally, each participant provided evaluations and metaperceptions of each team member on five-point rating scales. Specifically, participants rated each team member on 12 evaluative adjectives: *self-controlled*, *mature*, *broad-minded*, *optimistic*, *wise*, *understanding*, *purposeful*, *alert*, *generous*, *clear-headed*, *considerate*, and *reasonable* (Saucier, 1994 [37]), and then rated how they thought each team member rated them on each characteristic (metaperceptions). Each item was accompanied by a five-point rating response scale (1 = *not at all* to 5 = *very much*).

3. Analysis

A social relations analysis (Kenny & LaVoie, 1984 [31]) analyzed the latent constructs for evaluations and metaperceptions into their expected sources of nonindependence using the TripleR package in R. Due to restrictions of the number of manifest variables that can be accommodated in the program, the twelve items for each construct were divided into two subsets of six items. An average score was computed for each subset. This procedure yielded two manifest variables for each construct and allowed for a multivariate approach to the analysis. If a univariate approach was used, the relationship (dyad) variance would be confounded with the error variance. Given the important role of relationship variance that has been confirmed in past research (LeDoux et al., 2012 [15]), it was particularly important to isolate relationship variance from error variance in the current analysis.

In addition to providing variance components for the sources of interpersonal perceptions, the analysis also provided the covariances required to examine meta-accuracy and perceived reciprocity. Estimates for generalized meta-accuracy are indicated by a covariance between the target effects in evaluations and the perceiver effects in metaperceptions. Dyadic meta-accuracy is indicated by the covariance between evaluation and metaperception relationship effects; in this case, the evaluation effects are provided by one team member and metaerception effects are from another team member (i.e., interpersonal). Generalized reciprocity is reflected in the covariance between a team member's perceiver effects in metaperception

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[1] Participants also completed an individual spatial reasoning task that was scored for accuracy and number of items attempted. Exploratory analyses suggested that role change did not relate to cognitive performance (b = -0.68, p = .64) or number of items answered (b = -1.52, p = .23). When change occurred, more

differentiation of partners in evaluations (evaluation relationship variance) was associated with more cognitive items attempted by group members (b = 45.02, SE = 18.49). No other analyses with cognitive score or number of items attempted were statistically significant.

and that same person's perceiver effects in their evaluations of others. Dyadic reciprocity is indicated by the covariance in relationship effects from evaluations and metaperceptions; this time, it is the covariance between a team member's metaperception relationship effects and that individual's own evaluation relationship effects (i.e., intrapersonal).

The variance and covariance component patterns were compared between teams that experienced change and those that did not experience change. Note that this analysis only incorporated groups without missing data (g = 29 for evaluations; g = 24 for metaperceptions and all correlations between the perceptions).

We then used multilevel analyses using the lme4 package in R to test effects of team level predictors (change, variance components) on team member affective experiences and perceptions of team outcomes.

4. Results

4.1 Role change and group mean outcomes

Multilevel models indicated that role change analyzed at the team level did not yield significant differences in team members' reported quality of the outcome (b = .001, p = .99), positive affect (b = 0.56, p = .80), negative affect (b = -0.97, p = .35), evaluations of team members (b = -0.19, p = .19), or metaperceptions of team members (b = -0.19, p = .19) among participants. Thus, when examining only mean score differences across teams, the analysis detected no evidence for disruption in interpersonal processes.

4.2 Sources of variance in perceptions

The social relations analysis revealed significant perceiver and relationship variances in both evaluations and metaperceptions (see Table 1). When virtual teams that experienced role change were examined separately from those that experienced no change, the subsamples showed similar source patterns. The results suggest that evaluations of team members and expected evaluations from team members (metaperceptions) were driven by the raters' general rating style (perceiver variance) and some degree of differentiation among targets (relationship variance).

Independent samples t tests examined if the variance components for the groups differed depending on whether role change occurred or not. The relationship variance components were significantly larger in the teams that experienced role

change compared to teams that did not experience role change (p = .04). This suggests that raters might have differentiated targets more in the teams that experienced role change.

Table 1. Social Relations Analysis Components for Interpersonal Perceptions

	Perceiver	Target	Relationship	Error
Total Sample				
Evaluations g = 29	0.22(0.50)*	0.01(0.03)	0.13(0.29)*	0.08(0.19)
Metaperceptions g = 24	0,46(0.83)*	0.003(0.006)	0.03(0.04)*	0.07(0.13)
Role Change				
Evaluations g = 16	0.22(0.45)*	0.01(0.02)	0.18(0.38)*	0.07(0.14)
Metaperceptions g = 14	0.42(0.78)*	0.003(0.005)	0.03(0.07)*	0.08(0.15)
No Change				
Evaluations g = 13	0.22(0.56)	0.02(0.04)^	0.06(0.15)*	0.10(0.25)
Metaperceptions g = 10	0.53(0.87)*	0.004(0.006)	0.01(0.02)	0.06(0.10)

NOTE: Unstandardized components are presented with standardized components in parentheses. ^ p < .10; * p < .05

4.3 Reciprocity and meta-accuracy

At the team level, metaperceptions and evaluations were highly correlated with each other (*r* = .80, *p* < .001). Given the sources of variance identified, we considered four bivariate relationships among the effects. Generalized reciprocity, indicated by the relationship between the perceiver effects in evaluations and the perceiver effects in metaperceptions, was positive and significant in the full sample (see Table 2). The effect was consistent in teams that did and did not experience role changes.

Dyadic reciprocity was indicated by the covariation between the relationship effects for evaluation and that same rater's relationship effects in metaperceptions (intrapersonal). This was significant in the full sample and in the subsample of teams that did not experience role change. However, the effect was not significant in the subsample of teams that experienced role changes. In the teams that did not experience role changes, raters seemed to rate specific team members similarly to how they expected those specific team members to evaluate them. There is no evidence to suggest this to be the case when teams experienced role changes.

Generalized meta-accuracy was measured by the relationship between target effects in evaluations with perceiver effects in metaperceptions. Generalized

meta-accuracy was not significant in the full or either subsample of teams. However, it is interesting to note that the correlation was positive in teams that did not experience changes but negative and near zero in teams that did have role changes. Given that the target variance component in evaluations was not significant in this analysis, results for generalized meta-accuracy should be interpreted with caution.

Finally, dyadic meta-accuracy was measured by interpersonal covariances between relationship effects for evaluation and metaperception. Dyadic meta-accuracy was positive and significant for the full sample and the subsample of teams that experienced role changes, but not for teams that did not experience role changes. This suggests that dyadic meta-accuracy might be better in those teams that experienced role changes. Stated another way, team members seemed to have a better sense of how specific partners evaluated them in virtual teams that experienced role change compared to those who did not.

Table 2. Bivariate Relationships for Perceptions from Social Relations Analysis

	Total Sample	Role Change	No Change
Generalized Reciprocity	0.25(0.78)*	0.25(0.80)*	0.27(0.77)*
Dyadic Reciprocity	0.02(0.41)*	0.02(0.24)	0.03(1.00)*
Generalized Meta-accuracy	0.01(0.07)	-0.002(-0.003)	0.02(0.17)
Dyadic Meta-accuracy	0.02(0.31)*	0.02(0.28)^	0.01(0.42)

NOTE: Unstandardized components are presented with standardized components in parentheses. ^ p < .10; * p < .05

4.4. Perceptions and team outcomes

The next question to address is whether these patterns of interpersonal perceptions have implications for individual team member experiences and perceptions of team outcomes. When aggregated to the team level for analysis, both metaperceptions ($r = .39$, $p = .03$) and evaluations ($r = .59$, $p < .001$) were significantly related to the team members' perceived quality of the decision outcome. At the team level, evaluation and metaperceptions within virtual teams seem to have implications for perceived quality of team outcomes.

Perceiver and relationship variance in metaperceptions did not significantly relate to positive affect, negative affect, or overall quality perceptions of the team ($p > .10$). Thus, there is no evidence to suggest that the strategies used by individuals to understand how they are viewed by their team members influenced their affective experiences or perception of outcome quality.

Variance components in evaluations, however, predicted affective experiences and team outcome quality perceptions among team members. More perceiver variance in evaluations was associated with more negative evaluations within teams ($b = -0.93$, $p = .01$). This suggests that teams in which individuals rated their team members similarly were more likely to rate those others more negatively than teams in which members did not exhibit such tendencies.

Also, relationship variance in evaluations predicted more negative evaluations of team members ($b = -0.94$, $p = .01$). This finding suggests that teams in which members differentiated their team members more also showed more negative evaluations than in teams where less differentiation occurred.

Variance components also predicted perceptions of quality in team outcomes. Specifically, relationship variance in evaluations predicted lower perceptions of overall quality of the team ($b = -1.15$, $p = .005$). Thus, teams in which members differentiated evaluations of each other also reported lower quality perceptions in the team. The fact that role change teams showed more relationship variance might suggest that such teams are more susceptible to the negative evaluations and overall team quality perceptions that seem to be associated with higher relationship components. This finding also suggests that the greater differentiation among tam members might be a sign of conflict within the teams.

The results from the variance partitioning provide some insight into how being in a team that experienced change might affect team interpersonal processes and individual experiences. Examining bivariate relationships reflecting meta-accuracy and reciprocity in perceptions may provide some additional insight into the interpersonal processes within these virtual teams. However, this analysis only showed significant predictions involving generalized meta-accuracy. Generalized meta-accuracy predicted less positive affect and lower overall quality perceptions among team members ($p < .05$).

5. Discussion

In a virtual team context, interpersonal processes are particularly important to monitor as they may have important consequences for team effectiveness. Social disruptions such as role changes might occur quite frequently, especially if virtual teams take on features

of self-managed teams with rotating leader roles. However, even if such changes are adaptive in virtual team environments, they might disrupt interpersonal processes among team members. The impact of such disruptions might not be observable when only considering mean score differences in reported experiences across teams. Changes that occur within complex multilevel systems might have implications for individual members and relationships within those systems. The present analysis found that, although a negative interpersonal impact of role change was not observed in mean score differences in affective experiences or reported quality of team outcomes, the systematic sources of interpersonal perceptions did uncover differences in the way in which team members formed evaluations of each other. Importantly, these patterns had implications for affective experiences and perceptions of quality of team outcomes.

From the variance partitioning approach in a social relations analysis, we learned that metaperceptions in virtual teams were driven primarily by perceiver variance. Such a pattern in metaperceptions would be predicted by past research (e.g., Malloy & Janowski, 1992 [33]). Additional research by the first author has found that the failure to adjust metaperceptions according to one's negative social label can lead to lower meta-accuracy (Santuzzi, 2015 [38]). Thus, relying on one's general tendencies to expect to be rated by others in a certain way might indicate weak interpersonal processes within the team. With strong relationships, we would expect more relationship variance in metaperceptions, indicating differentiation among team members.

Perceiver variance also was a strong component in evaluations of team members, suggesting a similar pattern of consistent ratings across team members as observed with metaperceptions. However, we also observed a strong relationship variance component in evaluations that we did not see with metaperceptions. This suggests that team members did differentiate their evaluations of each other in the virtual teams. Moreover, the relationship component appeared to be stronger in virtual teams that experienced role change than in those that did not experience such change. Strong relationship variance suggests differentiating among team members in evaluations. However, the variance component itself does not inform whether those evaluations of team members are positive or negative. Thus, it was important to also consider the extent to which the relationship variance predicts individual experiences and perceptions in the virtual teams. The analysis revealed that a larger relationship variance component was associated with more negative evaluations of team members and perceptions

of quality of team outcomes. Taken together, the larger relationship variance component observed in teams that experienced role change might reflect interpersonal conflict within the team rather than positive bonding experiences.

We also learned that dyadic meta-accuracy was stronger in teams that experienced change. This suggests that team members understood how specific other team members evaluated them. Meta-accuracy reflects team members' ability to know how they stand in the team, which facilitates the development of an overall mental model of how the team functions. Therefore, higher meta-accuracy should be associated with better team coordination. This finding is intriguing given that the virtual teams experiencing role change appeared to be more susceptible to negative perceptions of team outcome quality. One plausible explanation is that virtual teams respond to changes by establishing swift trust but not necessarily positive bonding. This is somewhat supported by the finding that dyadic reciprocity—the extent to which team members reciprocate the evaluations that they expect from their partners—was lower in virtual teams that experienced role change. Under those conditions, team members might have appropriately adjusted their expectations downward for how team members might evaluate them, leading to less positive bias and more accuracy in metaperceptions. This explanation requires some reconceptualizing of the term "trust" in virtual teams, which may be established without positive regard.

5.1 Implications for virtual team dynamics

These findings might contribute to ongoing debate about the role of trust in virtual teams (e.g., Jarvenpa, Knoll, & Leidner, 1998 [39]). Expecting some team members to hold negative evaluations of the self would detract from the trust development process if trust is assumed to reflect positive regard. According to the results of the present analysis, disruptions to the social system within virtual teams might contribute to the low interpersonal trust development in virtual teams if positive regard (e.g., cohesion) is assumed to overlap with trust. If trust can be obtained within teams without requiring positive regard, virtual teams might be well-positioned to understand their interpersonal processes in times of disruption and change. Further research should examine whether the pattern observed in this analysis is specific to short-term project teams in which keeping the team in tact over a period of time is not a main objective; thus, positive bonding and cohesion may not be as critical to accomplishing team objectives.

Although past research on face-to-face team performance would suggest that disruption to interpersonal processes and positive perceptions in teams would yield reduced team effectiveness, some research and conceptualizing suggests that the situation might not be as detrimental to virtual team performance. Research has shown that virtual teams might be less dependent on social factors to perform team functions (Aiello & Kolb, 1995 [40]; Gonzalez, Burke, Santuzzi, & Bradley, 2003 [41]). Therefore, changes in the roles and relationships within the teams might influence interpersonal perceptions and interpersonal processes within the team, but they might not have the same direct impact on the work outcomes of the teams as might occur in traditional, face-to-face teams (King, Kaplan, & Zaccaro, 2007 [42]; Martins et al., 2004 [5]). Future research should continue to examine whether interpersonal processes and perceptions play weaker roles in virtual team effectiveness than in face-to-face teams.

5.2 The value of social relations analysis

The impact of disruption on interpersonal processes within virtual teams was not evident when examining mean score differences in evaluations, affective experiences, and perceived quality of outcomes across teams. The variance partitioning approach used in the social relations analysis allowed us to uncover interpersonal processes that were integrated into the multilevel structure of the teams. Teams have multiple sources of influence on team experiences, including individual team member personalities, relationships between specific team members, and shared team experiences. In order to identify interpersonal processes within teams, these systematic sources of influence must be accounted for in an analysis. The social relations analysis is designed for this purpose.

Continued research on virtual teams and other complex multilevel systems would benefit from incorporating social relations analysis to identify similar sources of influence on team experiences. As demonstrated in this analysis, several sources of influence may influence interpersonal processes and, importantly, those sources may change as the features of the team environment change. Identifying the sources of influence on interpersonal processes in virtual teams may lead to insights into how different types of virtual teams function and whether unique interpersonal processes are involved in virtual teams that are not evident in face-to-face collaborations.

5.3 Conclusions

Role changes and other disruptions commonly occur in virtual team collaborations. According to the results of the present study, such changes might not appear to have a negative impact at the team level of analysis. However, relying on specialized analytic techniques such as the social relations analysis can identify how interpersonal processes within teams are affected by change. These effects were demonstrated in the patterns of interpersonal perceptions that team members formed of each other that differed between teams that did and did not experience change. Researchers and practitioners should be aware of these often hidden social consequences of role changes and other disruptions in virtual teams.

6. References

[1] D.A. Kenny, Interpersonal perception: A social relations analysis, Guilford Press, 1994.

[2] B.B. Baltes, M.W. Dickson, M.P. Sherman, C.C Bauer, and J.S. LaGanke, "Computer-Mediated Communication and Group Decision Making: A Meta-Analysis", Organizational Behavior and Human Decision Processes, Elsevier, 2002, pp. 156-179.

[3] A. Ortiz de Guinea, J. Webster, and S. Staples, "A Meta-Analysis of Virtual Teams Literature", In Symposium on High Performance Professional Teams Industrial Relations Centre, School of Policy Studies, Queen's University, Kingston, Canada, 2005.

[4] J.R. Hackman, and C.G. Morris, "Group Tasks, Group Interaction Process, and Group Performance Effectiveness: A Review and Proposed Integration", Advances in Experimental Social Psychology, Elsevier, 1975, pp. 45-99.

[5] L.L. Martins, L. L. Gilson, and M.T. Maynard, "Virtual Teams: What Do We Know and Where Do We Go From Here?", Journal of Management, Elsevier, 2004, pp. 805-835.

[6] M.A. Marks, J.E. Mathieu, and S.J. Zaccaro, "A Temporally Based Framework and Taxonomy of Team Processes", Academy of Management Review, Academy of Management, 2001, pp. 356-376.

[7] J.E. McGrath, Groups: Interaction and Performance, Prentice Hall, Englewood Cliffs, NJ, 1984.

[8] R.D. Laing, H. Phillipson, and A.R. Lee, Interpersonal Perception: A Theory and a Method of Research, Springer, New York, 1966.

[9] D.T. McAllister, Affect- and Cognition-Based Trust as Foundations for Interpersonal Cooperation in Organizations, Academy of Management Journal, Academy of Management, 1995, pp. 24-59.

[10] S.W.J. Kozlowski, and B.S. Bell, Work Groups and Teams in Organizations, Handbook of Psychology, Wiley, 2003.

[11] B.J. Alge, C. Wiethoff, and H.J. Klein, "When Does the Medium Matter? Knowledge-Building Experiences and Opportunities in Decision-Making Teams", Organizational Behavior and Human Decision Processes, 2003, pp. 26-37.

[12] J.K. Summers, S.E., Humphrey, and G.R. Ferris, "Team Member Change, Flux in Coordination, and

Performance: Effects of Strategic Core Roles, Information Transfer, and Cognitive Ability", Academy of Management Journal, Academy of Management, 2012, pp. 314-338.

[13] C.R. Berger and R.J. Calabrese, "Some Explorations in Initial Interaction and Beyond: Toward a Developmental Theory of Interpersonal Communication", Human Communication Research, Wiley-Blackwell, 1975, pp. 99-112.

[14] S.K. Baard, T.A. Rench, and S. W. Kozlowski, "Performance Adaptation: A Theoretical Integration and Review", Journal of Management, Sage, 2014, pp. 48-99.

[15] J.A. LeDoux, C.A. Gorman, and D.J. Woehr, "The Impact of Interpersonal Perceptions on Team Processes", Small Group Research, Sage, 2012, pp. 356-382.

[16] A. Powell, G. Piccoli, and B. Ives, "Virtual Teams: A Review of Current Literature and Directions for Future Research", ACM Sigmis Database, ACM, New York, 2004, pp. 6-36.

[17] C.E. Galyon, E.C. Heaton, T.L. Best, and R.L. Williams, "Comparison of Group Cohesion, Class Participation, and Exam Performance in Live and Online Classes", Social Psychology of Education, 2016, pp. 61-76.

[18] G. Olson, and J. Olson, "Distance Matters", Human-Computer Interaction, Taylor and Francis, 2000, pp. 139-178.

[19] W.R. Clark, L.A. Clark, and K. Crossley, Developing Multidimensional Trust Without Touch in Virtual Teams", The Marketing Management Journal, pp. 177-193.

[20] L.L. Gilson, M.T. Maynard, N.C. Jones Young, M. Vartiainen, and M. Hakonen, "Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities", Journal of Management, 2015, pp. 1313-1337.

[21] S. Kiesler, J. Siegel, and T.W. McGuire, "Social Psychological Aspects of Computer-Mediated Communication, American Psychologist, American Psychological Association,1984, pp. 1123-1134.

[22] L.C. Tidwell and J.B. Walther, "Computer-Mediated Communication Effects on Disclosure, Impressions, and Interpersonal Evaluations: Getting to Know One Another a Bit at a Time", Human Communication Research, Wiley-Blackwell, 2002, pp. 317-348.

[23] S. Jarvenpaa and D. Leidner, "Communication and Trust in Global Virtual Teams, Organization Science, 1999, pp. 791-815.

[24] A.M. Santuzzi, C.J. Budnick, and D.L. Cogburn, "Human Computation and Collaboration: Identifying Unique Social Processes in Virtual Contexts", Handbook of Human Computation, Springer, 2013, pp. 715-723.

[25] S.A. Rains, "The Impact of Anonymity on Perceptions of Source Credibility and Influence in Computer-Mediated Group Communication: A Test of Two Competing Hypotheses", Communication Research, 2007, pp. 100-125.

[26] Johnson, Bettenhausen, and Gibbons, 2009

[27] S.J. Zaccaro, S.D. Ardison, and K.L. Orvis, "Leadership in Virtual Teams", In D.V. Days, S.J. Zaccaro, and S.M. Halpin (Eds.), Leader Development for Transforming Organizations, Erlbaum, Mahwah, NJ, 2004, 267-292.

[28] M.L. Shuffler, C.W. Wiese, E. Salas, and C.S. Burke, "Leading One Another Across Time and Space: Exploring Shared Leadership Functions in Virtual Teams", Revista de Psicología del Trabajo y de las Organizaciones, 2010, pp. 3-17.

[29] C. Breuer, J. Hüffmeier, and G. Hertel, "Does Trust Matter More in Virtual Teams? A Meta-Analysis of Trust and Team Effectiveness Considering Virtuality and Documentation as Moderators", Journal of Applied Psychology, 2016, pp. 1151-1177.

[30] C. Haney, and P.G. Zimbardo, "Social Roles and Role-Playing: Observations from the Stanford Prison Study", Current Perspectives In Social Psychology, Oxford University Press, New York, 1976, pp. 266-274.

[31] D.A. Kenny and L. LaVoie, The Social Relations Model, Advances in Experimental Social Psychology, Elsevier, 1984, pp. 141-182.

[32] D.A. Kenny, and S. Livi, "A Componential Analysis of Leadership Using the Social Relations Model", In F.J. Yammarino and F. Dansereau (Eds.), Multi-Level Issues in Organizational Behavior and Leadership, Emerald, Bingley, UK, 2009, pp. 147-191.

[33] T.E. Malloy and C.L. Janowski, "Perceptions and Metaperceptions of Leadership: Components, Accuracy, and Dispositional Correlates", Personality and Social Psychology Bulletin, Sage, 1992, pp. 700-708.

[34] D. Watson, L. Clark, and A. Tellegen, "Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales", Journal of Personality and Social Psychology, American Psychological Association, 1988, pp. 1063-1070.

[35] G. Stasser, and D. Stewart, "Discovery of Hidden Profiles by Decision Making Groups: Solving a Problem Versus Making a Judgment", Journal of Personality and Social Psychology, American Psychological Association, 1992, pp. 426-434.

[36] R.A. Cooke and J.C. Lafferty, Group Styles Inventory, Plymouth, MI, Human Synergistics, 1988.

[37] G. Saucier, "Separating Description and Evaluation in the Structure of Personality Attributes", Journal of Personality and Social Psychology, American Psychological Association, 1994, pp. 141-154.

[38] A.M. Santuzzi, "Sex Composition Disrupts the Accuracy of Women's Metaperceptions of Partners", Small Group Research, 2015, pp. 395-414.

[39] S.L. Jarvenpaa, K. Knoll, and D.E. Leidner, "Is Anybody Out There?: Antecedents of Trust in Global Virtual Teams", Journal of Management Information Systems, Taylor and Francis, 1998, pp. 29-64.

[40] J.R. Aiello and K.J. Kolb, "Electronic performance monitoring and social context: Impact on productivity and stress", Journal of Applied Psychology, American Psychological Association, 1995, pp. 339-353.

[41] M.G. Gonzalez, M.J. Burke, A.M. Santuzzi, and J. Bradley, "The Impact of Group Process Variables on the Effectiveness of Distance Collaboration Groups", Computers in Human Behavior, Elsevier, 2003, pp. 629-648.

[42] E.B. King, S. Kaplan, and S. Zaccaro, "Metaperceptions in Diverse Workgroups: Intrapersonal Perspectives and Intragroup Processes", In B. Mannix, M. Neale, and K. Phillips (Eds.), Research on Managing Groups and Teams, Elsevier, Oxford, UK, 2008.