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A methodological reconsideration of the individual differences perspective

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Personality research in teams

Team research has long lead the way in research about personality in teams. Meanwhile, personality psychology research is about differences between people and not teams. In my dissertation, I elaborate on how we can study individual differences in team constellations, with persons, not teams, as our unit of analysis. The dissertation is about both team research and personality psychology. But it is also a methodological attempt to challenge our research focus on variables, to explore what can be learnt about them if we instead look to another dimension of data.

I suggest that personality and individual differences can be studied in team constellations if we consider the entity dimension of data. Examples that I present in the dissertation are studies of individuals across teams, as opposed to within- or between teams, yet in relation to the team structure of data.

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A methodological reconsideration of the individual differences perspective

Rebecka Persson

LUND
UNIVERSITY

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Personality research in teams -a methodological reconsideration of the individual differences perspective

Abstract

The aim of this doctoral dissertation was to investigate whether the application of personality in team research can be performed so that the individual differences, that are typically studied in personality research, are maintained. Two different approaches to apply personality to team research, without changing the unit of study from individuals to teams, were suggested and demonstrated with example data. Personality in individuals was related to team process perceptions in individuals, to evaluate construct overlap. Personality in individuals was also related to team outcomes by team role subgroups of individuals. Team role subgroups were additionally used to study if individual differences are useful when we study team processes. The different units of analysis in personality- and team research were discussed in relation to the dimension of data that is about persons or entities (Cattell, 1952).

In **Study 1**, we studied whether team process perceptions of individuals had relationships with personality traits. Furthermore, we addressed how such construct content overlaps may affect team level relationships. It was suggested that personality traits be applied at the individual level in team process research, instead of at the team level.

In **Study 2** I addressed the possibility to relate individual level personality to team level outcomes, by dividing the sample of individuals into team role subgroups. It was illustrated how team data must be restructured to enable analysis. Interaction effects were suggested as a means of addressing interdependence in teams.

With **Study 3,** my aim was to investigate whether the individual level variability of team processes would be meaningful to understand team processes. I used team role subgroups to show how we can evaluate whether team processes develop differently in team members of same teams.

The method in common to the three studies was that individuals were studied across teams, instead of within or between teams, yet in relation to the team structure of data.

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To my mother, Ingrid, and my sister, Kristina, who are my everything. This dissertation is also written in loving memory of my grandfather, who taught me to study.

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Acknowledgements

Rebecka Persson

Stockholm, December 2021

List of studies

The doctoral dissertation is based on the following three studies, hereafter referred to as Study1, Study 2 and Study 3.

Study 1   Persson, R., Bäckström, M., & Delmar, F. (2021). The Personality Trait Component of Team Processes. *Submitted.*

Study 2   Persson, R. (2020). Personality of New Venture Executives and New Venture Performance– an Individual Level Subgroup Approach to Personality in Teams. *Submitted.*

Study 3   Persson, R. On the Potential of Individual Level New Venture Team Roles to Understand Team Process Development Over the Course of New Venture Creation.

Abstract

The aim of this doctoral dissertation was to investigate whether the application of personality in team research can be performed so that the individual differences, that are typically studied in personality research, are maintained. Two different approaches to apply personality to team research, without changing the unit of study from individuals to teams, were suggested and demonstrated with example data. Personality in individuals was related to team process perceptions in individuals, to evaluate construct overlap. Personality in individuals was also related to team outcomes by team role subgroups of individuals. Team role subgroups were additionally used to study if individual differences are useful when we study team processes. The different units of analysis in personality- and team research were discussed in relation to the dimension of data that is about persons or entities (Cattell, 1952).

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Summary in Swedish

Syftet med den här avhandlingen var att undersöka om användningen av personlighet i teamforskning kan göras på ett sådant sätt att individuella skillnader, som är det som typiskt studeras i personlighetsforskning, bibehålls. Två olika sätt att applicera personlighet i teamforskning, utan att ändra analysenheten från individer till team, föreslogs och demonstrerades med exempeldata. Personlighet hos individer relaterades till individernas skattningar av teamprocesser, för att studera överlappande betydelse mellan personlighet och teamprocesser. Personlighet hos individer relaterades också till teamutfall via individernas teamroller. Dessutom relaterades teamroller till individers teamprocesskattningar för att undersöka om individuella skillnader är användbara också när vi undersöker teamprocesser. Olika analysenheter i personlighets- och teamforskning diskuterades i relation till dimensionen av data som handlar om personer eller enheter (Cattell, 1952).

I **Studie 1** undersökte vi om teammedlemmars teamprocesskattningar hade relationer till personlighetsegenskaper. Dessutom adresserades hur mycket sådana överlappande betydelser kan påverka relationer på teamnivå. Det föreslogs att personlighetsegenskaper borde appliceras på individnivå när man forskar om teamprocesser.

I **Studie 2** undersökte jag möjligheten att relatera personlighet till utfall på teamnivå, genom att dela upp urvalet av individer i subgrupper enligt deras teamroller. Det illustrerades hur data behöver omstruktureras för att analys ska vara möjlig. Interaktionseffekter föreslogs som ett sätt att adressera teammedlemmars beroende av varandra.

I **Studie 3** ville jag undersöka om variation i teamprocesskattningar på individnivå kan vara meningsfullt för att förstå teamprocesser. Jag använde subgrupper, enligt teamroller, för att visa hur vi kan utvärdera om teamprocesser utvecklas på olika sätt hos medlemmar av samma team.

Metoden som var gemensam för de tre studierna var att individer studerades över team, istället för inom- eller mellan team, men ändå i relation till teamstrukturen i data.

Introduction

This dissertation is about the application of personality research to teams. The use of personality variables to study teams is different from many other applications of personality research. This is because it is often necessary to somehow summarize, or aggregate, personality data from individual team members to a score that represents the whole team, so that it can be statistically related to other team properties. To aggregate scores is common procedure in team research when personality is studied, although it has long been known in social sciences that aggregated data often are inflated estimates of lower-level relationships (Klein & Kozlowski, 2000; Robinson, 1950; Thorndike, 1939). It is the lower-level nature of personality data, which also holds when personality is applied in team research, that this dissertation is about. Aggregating data from individuals into team scores can be done with a variety of statistical renderings, yet it is different than comparing individuals to one another. That is to say, teams are groups of individuals, but the scientific study of personality is about *individual differences*, -differences between individuals (e.g., Paunonen & Hong, 2015).

Data has three dimensions. They are variables, entities and measurement occasions (Cattell, 1952; Little, 2013). In social sciences, we focus on variables and their relationships to one another (Howard & Hoffman, 2018). This is the case also for the research areas that I address in this dissertation, namely personality research, team research and the combination of the two. The priority of variables however poses a problem when we study personality in teams, since individuals and teams are different entities. Whilst the time or measurement occasion dimension of data is integrated in team research and its modern methodological advancements (e.g., Gardner & Quigley, 2015; Lang et al., 2019; Lang et al., 2021; Marks et al., 2001; Mathieu et al., 2014; Morgeson et al., 2015), the entity dimension is less explored. But when team- and personality research is combined, we have good reasons to attend to the entity dimension of data. The focus on variables that is typical to social sciences may disguise the potential problem with using personality traits in teams. It seems intuitive that personality variables are possible to study in teams. An elaborate literature is available about collective constructs, i.e., variables, in teams and organizations (e.g., Bliese et al., 2007; Chan, 1998; Kozlowski & Klein, 2000; Mathieu et al., 2020; Morgeson & Hofmann, 1999). Personality is however not just defined by variable content, trait by trait. The conventional overarching definition of personality traits directly addresses what entity personality traits are about;

individuals (e.g., Funder, 2001; Paunonen & Hong, 2015; Revelle & Condon, 2015). That is, without considering the entity dimension of data when we use personality variables, we risk to neglect alterations in one of the three dimensions of data. The neglect may be consequential to our scientific thinking, research procedures and our conclusions.

With this dissertation, I aim to show how the entity dimension of data can be attended to in the linkage of individual differences and teams, and I suggest a few ways to pursue this particular line of thinking. As such, I don't present results with claims of new empirical findings, or replications of previous findings. Nor do I present new theoretical contributions based on previously suggested theoretical frameworks. Instead, I consider the application of individual differences personality research in team constellations from a methodological perspective. Much work remains and it is my hope that the dissertation leaves its readers with more ideas of future tasks and problems to address, than there are problems and procedures suggested in the work at hand. For the study of personality as individual differences in teams, with the entity dimension for a starting point, is still at its very beginning.

In the dissertation studies, I suggest how we can use personality or individual differences in the study of teams, with the individual entity maintained in data. First, I suggest that personality can be related to team process ratings at the individual level of analysis. The purpose is to study how much variability that is due to personality rather than to team processes, when team members rate their own team processes. As such, personality can be used to evaluate team process measurement, rather than to predict team processes. My second suggestion is about how to relate personality in several team members to team level outcomes, with personality kept at the individual level of analysis. I suggest this is possible by restructuring data according to team member roles, and relate subgroups of individuals, instead of team clusters, to team outcomes. Last, again with a subgroup approach, I suggest that new venture team roles can be used to study team process perceptions in individuals, during the course of new venture development. That is, individual differences in team processes can be studied next to team units of analysis, to contribute to our understanding of team processes both in teams and in individuals according to their team roles. Data in the dissertation comes from a longitudinal research project about new venture teams, "The Swedish Longitudinal data on New Venture Teamwork" (Brattström et al., 2020). The entrepreneurship field of research, that new venture teams belong to, is a field of research in which the unit of analysis can be either individuals or teams (Bjornali et al., 2017; Brandstätter, 2011; Klotz et al., 2014)

I started the dissertation work believing that I would study the effects of personality in teams on team processes and both team- and business outcomes in new venture teams. I was very interested in personality when I started, but as it would turn out, what I was interested in was a specific aspect of personality. Data collection took a lot of time and effort. When it was time to sit down and in detail plan what my studies

would look like, I faced problems. It was as if I had lost my appetite. I couldn't immediately pin down what was the matter, but I clearly remember that I was feeling blue by the many studies on team personality that I read. I had stopped reading personality research, it wouldn't add up in my head any more. And then I suddenly got it! It is the differences between people that I am interested in. What more exciting context than teams, can differences between people take place in? But, where were the differences in the team personality studies I had read? I could think again! Little did I know what a long array of steps that still were to be taken before this dissertation could be written. In essence, the two research fields of personality- and team research are perhaps on a glance not at all that different. The perhaps most fundamental difference is incredibly basic. It is so basic that it could pass unnoticed. I searched in statistics. I spoke to respondents in our data collection. I distracted myself with missing data theory. I wrote my paper manuscripts, still searching and hesitating. I read a book about invariance testing and estimated growth curves. It is of course easier hindsight. I read the fine print and missed the large sign. The difference is not in statistics, but statistics can help us manage the difference. The difference is in what we study. Or, if you would like, the difference is in the perspective on data. There wouldn't be any effects of personality in teams, at least not the way I thought at the beginning. Instead the dissertation work leads down a methodological path.

What follows is an overview of the team- and personality research fields. Neither of the overviews are full accounts of team- or personality research, but they are broad descriptions of two research areas. After the overviews, the different entities that are individuals and teams are discussed, following an introduction to Cattell's data box. Last, I will describe my suggestions about how personality research can be applied to teams. The introduction is for the most part an overview of how personality is conceptualized in two different fields of research, and an introduction to the problem of combining them. The suggestions on how to think of and manage the problem is briefly reviewed, and will then be elaborated on in the three studies.

Team research

Many definitions of work teams have been suggested (Mathieu et al., 2008), and one of them has been proposed by Kozlowski and Bell (2012, p. 334). It defines teams as "collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain and manage boundaries, and are embedded in an organizational context that sets boundaries, constraints the team, and influences exchanges with other units in the broader entity". In another, shorter, definition of teams by Baker and Salas (1997), teams are two or more individuals who interact interdependently to reach common goals. Team research has a theoretical heritage both from social psychology and from system

theory (Arrow et al., 2000; Mathieu et al., 2017), from which the influential input-process-outcome (IPO) framework stems (McGrath, 1964). The model is depicted in Figure 1. Mathieu et al. (2008) describe inputs as antecedents or drivers of the sequent processes. Inputs can be both individual team member characteristics, like personality or work experience, and team characteristics, like task-types and team autonomy (Magpili & Pazos, 2018). Team processes are team member's interactions that are necessary to perform team tasks, and processes are also what transforms team inputs to team outcomes. Specifically, Marks et al. (2001, p. 357) defined team processes as "member's interdependent acts that convert inputs to outcomes through cognitive, verbal and behavioral activities directed toward organizing taskwork to achieve collective goals". Amongst team processes, a subcategory is emergent states (Rapp et al., 2021). Emergent states are "cognitive, affective and motivational states of teams" (Marks et al., 2001, p. 357) and differ from the processes that describe team member interactions. Outcomes in turn are results of team activity and include both how well teams perform and resulting emotional stances of team members, like e.g., team satisfaction (Mathieu et al., 2008). The IPO framework has been advanced over the years, predominantly with emphasis on the longitudinal mechanisms that are possible to add to the framework (Marks et al., 2001), and with extensions of it to include environmental factors that are external to the system (e.g., Cohen & Bailey, 1997). The advancements of the framework have resulted in a revised version of the IPO model. It refers to processes as mediators, and incorporates the reoccurrence of team work cycles. The revised model is called the input-moderator-outcome-input (IMOI) model (Ilgen et al., 2005).
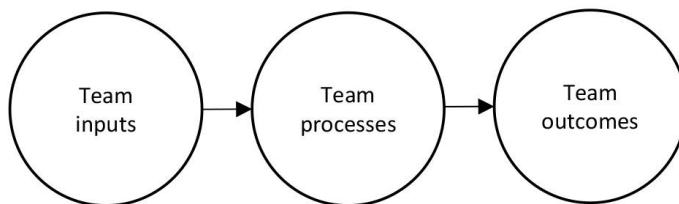
Figure 1. The IPO model

Note. The picture is based on Mathieu et al. (2008), p.413.

Personality in team research

It is in the input part of the IPO model that personality has been incorporated in team research (e.g., Peeters et al., 2008). As such, personality in teams is viewed as a factor that precedes team processes and thereby may influence team outcomes (Driskell et al., 1987; Hackman, 1987). When personality is studied in teams at the team level, it is in terms of *team composition*. Team composition is the configuration

of team member attributes or characteristics within teams, and it is studied both in relation to team processes and team outcomes (Kozlowski & Bell, 2012; Levine & Moreland, 1990; Wolfson & Mathieu, 2017). Bell (2007, p. 598) wrote that "composition variables pose a particular problem, because although individual difference variables are by definition at the individual level, the interest in team composition is in the unique combinations of individuals who compose a team (Mohammed et al., 2002), or how the individual level variables are combined to reflect a team-level operationalization".

At least thirteen review articles and meta-analyzes to date summarize findings and theoretical frameworks of personality team composition (Liu et al., 2015). They are based on hundreds of team-level studies about the five-factor model (FFM) of personality. Although these studies are spread in an array of research disciplines, they have most frequently appeared in organizational, applied, group study and social- and personality journals (Liu et al., 2015). Liu et al. (2015) pointed out that the four most cited works were written by business scholars and published in applied psychology journals. These authors refer to the four most cited articles as the "intellectual base and archetype"(p.541) of research that relates personality to organizational teams. Since these four articles are described as the intellectual center piece of the research in question, a brief review of them will follow.

The first of the four most cited works is a meta-analysis by Barrick and Mount (1991). It is about individual level personality, and results were that that conscientiousness was related to all studied job performance criteria in all the studied occupational groups. Relationships for other personality traits varied with both performance criteria and occupational group. The second article is a study of 51 teams by Barrick et al. (1998). They concluded that team mean- conscientiousness, agreeableness, extraversion and emotional stability were related to supervisor ratings of team performance. In addition, extraversion and emotional stability were related to team viability through social cohesion. The third work is a study of 61 student work groups by Barry and Stewart (1997). The authors concluded that extraversion was related to both processes and outcomes at individual- and team level. The individual level analysis was based on team peer ratings of others' effect on team processes and outcomes. Team level analysis was based on proportion of extraverted team members. The relationship of proportion of extraverted team members was curvilinearly related to task focus and group performance. Conscientiousness however had no relationships at individual- or team level of analysis, contrary to hypothesis. The fourth of the most cited articles in the overview by Liu et al. (2015) is a study by Neuman and Wright (1999). They found relationships between on the one hand, peer rated agreeableness and conscientiousness, and on the other hand performance. The relationships were found both at individual- and team level of analysis in a sample of 79 teams. In their study, personality at team level was represented by the lowest scoring team members per team.

In summary, the four publications illustrate that research findings about personality in teams is about personality that is assessed in individuals. They also highlight that the IPO model is guiding in the tests of personality as antecedents to processes and outcomes. Furthermore, they reveal that several ways of relating personality to team- processes or outcomes at team level are possible and conventional.

The main focus on the relationship between team personality composition and team performance in the four summarized articles, is largely representative for research on team personality (Liu et al., 2015). Studies about personality composition and team processes, instead of outcomes, have also been conducted (e.g.,Barrick et al., 1998; Bradley et al., 2013). Several large reviews and a meta-analysis have been published after the four summarized above. In her meta-analysis, Bell (2007) tested several team level operationalizations, e.g., both mean and variance values of team members' trait scores, in relation to team performance. Her work was further refined by Prewett et al. (2009), who included *task types* as moderators to the relationships between team personality composition and performance. Like Bell (2007) they found small, but significant, relationships. The idea that relationships between team personality and team performance depends on the type of tasks (Steiner, 1972) that teams perform has been suggested several times (LePine et al., 1997; Mohammed et al., 2002; Moynihan & Peterson, 2001; Neuman & Wright, 1999; Prewett et al., 2009). Bell (2007) furthermore suggested that *team type* is an important moderator between team personality composition and team performance, and she used a team type taxamony proposed by Devine (2002). In some of the reviewing works on team personality, the very team level operationalizations of personality has been tested as moderators (Bell, 2007; Prewett et al., 2009).

Taken together, it is difficult to summarize the research about team personality composition and team processes- and outcomes, even with help from the meta-analyzes and reviews. This is because results vary and sometimes contradict between studies. For an example, Bell (2007) did not find clear support for team personality, in terms of variances in teams as predictive to team performance. But Halfhill et al. (2005) found negative relationships between all FFM traits, operationalized as team variance, and performance. Research about team personality composition, or "team personality" as it is sometimes called in the reviews, is as such difficult to summarize with a set of replicating findings.

Individual level personality research in teams

Also individual level relationships have been studied in research about personality in teams. Then, the personality scores of individuals have been related to individual level outcomes, such as individual performance and trust (e.g., Furumo et al., 2009; Stewart et al., 2003). The team setting in these studies is the context to the relationships between personality and the outcome. I.e., the team environment may alter the effect of personality. As such, the individual level personality research in teams can be viewed as an extension of the interactionist personality research (Snyder & Ickes, 1985; Stewart et al., 2003). Tett and Burnett (2003) thoroughly presented the interactionist perspective in an organizational context including applications to teams. They argued that teams provide trait activation cues for individuals both through the task- and social environment that teamwork provides. With the interactionist perspective, team level attributes moderate the lower level relationship between personality traits and their influence on individual level outcomes, like e.g., task performance. For an example, LePine and Van Dyne (2001) suggested that team members adjust their behaviors towards less well performing team members, depending on how they perceive personality within the team.

As a note, it has been suggested that personality could be measured at team level, as "collective personality" (Farr & Sin, 2003; Smith & Schneider, 2004). Such an assessment would not be based on individual level measurement. For personality at team level only, Gardner and Quigley (2015) suggested that the definition of personality in individuals by Funder (2001) can be applied to teams. In their definition, team personality is "a team's characteristic patterns of thought, emotion and behavior, together with the social and psychological mechanisms behind these patterns, including internal social structures and processes" (p.367). This development towards team level analysis of personality is different from the vast majority of studies on personality in teams. It is different because it not assessed at individual level and not necessarily related to the personality of individual team members. More studies about this are needed, but English et al. (2004) compared team level measurement of conscientiousness with team aggregates of individual conscientiousness. They concluded that the measure designed to asses team level conscientiousness did not explain significantly more overall team performance than the aggregates of the individual level measure.

Team Composition

Findings about team personality come from a research area within team research that is called *team composition*. Team composition research studies combinations of team members' attributes (Bell et al., 2018), and not only combinations of team members' personality traits. Other attributes that team composition research studies are demographic variables like e.g., ethnicity, age, gender, level of education and

team work experience (e.g., Bell et al., 2011; Tyran & Gibson, 2008), but also other traits from differential psychology like e.g., cognitive ability (e.g., Devine & Philips, 2001; Randall et al., 2011). Since the research about team personality comes from team composition research, a certain description of that field is in place. Team composition research namely draws on a terminology about how member attributes manifest in teams.

Team personality studies that I have presented above are empirical examples from the team composition research, e.g., the meta-analysis of team personality by Bell (2007). In the overarching team research, team composition is placed in the input part of the IPO model of teams (Peeters et al., 2008). But team composition research is a particular subfield of team research, with a set of concepts to describe team member combinations of attributes; *composition- and compilation processes*. These two concepts help organize the variables in team composition research.

Composition and compilation processes are two different ways of thinking about and model team members' attributes at the team level (Mathieu et al., 2014). In other words, they are "aggregation-processes" (Mathieu et al., 2014, p. 132). The composition- and compilation terms are not unique to team research but also apply in organizational theory (Bliese, 2000; Kozlowski & Klein, 2000). Models that typically would be applicable in organizational research however differ from the procedures in team composition research. That is, models of relationships between variables in organizational research can involve the same variable at both the individual and the aggregated, organizational, level (e.g., Ostroff et al., 2005; Papaioannou et al., 2004). In multilevel modeling, such models are called contextual analysis models (Raudenbush & Bryk, 2002) and are used since they let researchers study the effect of the aggregated variable, after controlling for the effect at the individual level (Lüdtke et al., 2008). In team composition research, team member attributes are instead modeled at only team level, i.e., by some team wise statistical depiction of team member attributes. This is done to assess the combination of team members, in terms of a given variable and operationalization. Individual team members themselves do not display team compositions, but the team does. It has been recognized that concepts based on same variables may not have the same meaning at different levels of analysis (Bliese, 2000), and this is a key point in team composition research. It is team wise combinations of attributes that are studied (Bell et al., 2018; Mathieu et al., 2014), which is different from when we study attributes in individuals. Team wise combinations of member attributes can "emerge as collective team level phenomenon through compositional processes, compilational processes, or a hybrid of the two in any given circumstance" (Bell et al., 2018, p. 352).

Compositional aggregation of team member attributes are used when all individual team members are assumed to contribute to the team level composition characteristic equally much (Bell et al., 2018). Or, it could be said, when the phenomena, or variable, at hand is the same at both the individual and the team level (Kozlowski & Klein, 2000). So in a compositional aggregation of a personality trait,

each member score has the same team level weight, and the member scores are interchangeable. Furthermore, the variable content is the same at both individual and team level. Bell et al. (2018) describe an example of a compositional process, in which an accountant team in a pressured situation benefits from conscientious members, since they are likely to help each other out to complete the task. That is, the more conscientious each team member is, the more conscientious is the team. The trait levels of the individuals combine into the higher-level, team, variable. Kozlowski and Klein (2000) give another example about organizations. They argued that psychological- and organizational climate, seen from a compositional perspective, implies that both construct names refer to the same variable content and the same meaning, only at different levels. Organizations' climate come from shared perceptions amongst their members, which makes it a collective phenomenon. This notion of same construct- or variable meaning at different levels is called isomorphism (Kozlowski & Klein, 2000). The operationalization to illustrate the composition type of team process is usually the mean (Mathieu et al., 2014). Last, Bliese (2000) stated that truly isomorphic constructs likely are rare, and therefore perfect reliability of higher level constructs cannot be taken for granted when a construct, theoretically, is compositional.

Compilational aggregations of team member attributes are applied when interactions among team members' attributes are thought to occur. That is, when attributes of some team members have more influence than the same attributes in others. This disproportionate influence may e.g., be due to team roles or positions (Bell et al., 2018). Again Bell et al. (2018) used conscientiousness for an example. Conscientious team members are more likely to find themselves in "task completer roles" (Bell et al., 2018, p. 352), which may give more weight to the conscientiousness of individuals in those roles, in relation to team outcomes. As a result, the higher, team level, collective phenomenon is based on a more complex combination of team members' attributes with compilation processes (Kozlowski & Klein, 2000). Kozlowski and Klein (2000) further described that this concept is "functionally equivalent", i.e., that same content is present at different levels, yet aggregated and not aggregated data differ. Bliese (2000) wrote that with compilation models, it is expected that data vary within groups, and still the aggregated data is thought to assess a higher-level construct that is not accessible at the lower level. He took team personality diversity for an example, and emphasized that the aggregated level construct is theoretically different from the construct at the lower level. At the higher, team level, the construct is diversity, which is a group level measure. As such, with a compilation process perspective, it is the diversity of a personality trait variable in teams that can be related to team processes or outcomes, and not personality trait levels of team members per se. One typical operationalization to model compilation aggregations would be the standard deviation (Bell et al., 2018). On reliability of compilation constructs, Bliese (2000) stated that inter-group agreement and reliability is irrelevant in compilation models, since they are based on within group differences to form independent variables.

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It is noteworthy that the composition and- compilation terminology both is described as processes by which team members function together and as aggregations of variables. Seemingly, both a theoretical and a concrete operational meaning is ascribed to these two terms. However, the theoretical perspective are descriptions of how or why composition- and compilation processes can occur, whilst the operational rather is about researcher's data treatment.

The distinction between composition- and compilation models is not entirely clear cut. Again, compilation aggregations result in distinct constructs at different levels, and composition aggregation in the same construct content at different level. But since it is rare that concepts are truly isomorphic, i.e., that precisely the same construct content is represented at different levels (Bliese, 2000), a middle ground between the two aggregation processes has evolved (Lüdtke et al., 2008). When a variable is aggregated, the resulting higher-level variable likely contains variability that is related to the lower level variable. Yet it also differs from the lower level variable since it also contains contextual variability (Bliese, 2000; Firebaugh, 1978). This middle ground, Bliese (2000) calls *fuzzy composition processes*. It refers to the majority of composition aggregations in which the lower level variable not fully, but to some extent also is present at the aggregated level. In teams, individuals are typically at the lower level, and the aggregated level is the team level. With fuzzy composition processes, team level constructs that are based on aggregation are somewhere on a continuum between purely compositional processes and purely compilational processes (Lüdtke et al., 2008).

A logical consequence of different amount of variable content at different levels of analysis, is that aggregate relationships may be different from relationships at lower level. Our understanding and evaluation of relationships at aggregated level therefore relies on their reliability (Bliese, 2000). When a team level relationship is based on fuzzy composition aggregation, the individual level variable may however entail reliable variability that affects team level relationships. Bliese writes that group member's perceptions of a collective construct may be "unreliable because of individual differences in perceptions" (Bliese, 2000, p. 374). Tutz and Schauberger (2020, p. 447) indeed wrote that "individual-specific tendencies to respond to items irrespective of content can affect the reliability and validity of scale scores". Individual differences in perceptions of collective constructs are by definition not team- level content but would rather be an example of distinct, compilational, construct content. Yet, individual perception differences of some team level variable are housed in the continuum of fuzzy composition processes. That is, fuzzy composition processes involve both compositional- and compilation processes. Individual perception differences contribute on the compilational side of the aggregation process, since they are a form of within-group diversity (Kozlowski & Klein, 2000).

In summary, team personality research comes from team composition research that studies combinations of team member's attributes. As such, the use of personality

variables in this area of research is an example of applied use of psychological measurement and differential psychology.

Next, personality research will be briefly reviewed. More specifically, the personality research about personality traits will be presented, since it is this personality theory that has almost exclusively been applied in team research (Liu et al., 2015).

Personality trait research

Personality trait research is part of the scientific discipline of differential psychology, often called the study of individual differences (e.g., Chamorro-Premuzic et al., 2015). Funder (2001, p. 2) defined personality as "an individual's characteristic patterns of thought, emotion, and behavior". McCrae and Costa (2003, p. 25) have a very similar definition in "dimensions of individual differences in tendencies to show consistent patterns of thoughts, feelings and actions". That is, affect, behavior, cognition and desires in individuals have "inertial properties" (Revelle & Condon, 2015, p. 73). Hence, personality traits are about structural similarities and differences between individuals, that are used to both describe and explain behavior (Chamorro-Premuzic & Furnham, 2014). Personality traits are as such causal and internal, in that personality traits, rather than situations or contexts, influence behavior. The individual differences in trait personality research are based on the notion that individuals vary according to normal distributions (Paunonen & Hong, 2015) along the different personality trait dimensions (Rust & Golombok, 2014).

Personality traits have been extracted in natural language, i.e., descriptive words of humans that covary (Saucier & Goldberg, 2001). The technique by which this is done is called factor analysis (Digman, 1990; McCrae & John, 1992). The resulting solutions from factor analysis are hierarchical orders with groups of items at the lowest level, and higher order latent personality factors above them. Items are the descriptive statements in personality tests that individuals or their peers respond to with ratings on a scale. Self-rating is a common method of assessing personality (Paunonen & O'Neill, 2010). That the higher order factors, that represent personality traits, are latent reflect how personality traits are hypothetical constructs that can't be directly observed (Allport, 1937; Paunonen & Hong, 2015).

Over the decades, several suggestions have been made about how many higher order personality traits that are necessary to capture human personality. Cattell (1946) suggested 16 personality trait factors and Eysenck (1970) suggested three. More recent research has suggested two (Digman, 1997) and six (Ashton & Lee, 2007). The most conventional and most used framework in modern personality research (Chamorro-Premuzic & Furnham, 2014) has five overarching personality traits and is called the Five factor model (FFM) (McCrae & John, 1992).

The five factors in the FFM are named neuroticism, extraversion, openness to experience, agreeableness and conscientiousness. In often referred to work by McCrae and Costa (2003), each of the five factors have six facets that are underlying, lower order, traits. Neuroticism is the tendency to experience negative emotions , and the six facets are anxiety, angry hostility, depression, self-consciousness, impulsivity and vulnerability (McCrae & Costa, 2003). Extraversion is individual differences in the preference for social interaction and lively activity, and its facet are warmth, gregariousness, assertiveness, activity, excitement-seeking and positive emotions. Openness to experience is individual differences in the tendency to be involved in intellectual activities and prefer new experiences and ideas. The six facets of openness to experience are fantasy, aesthetics, feelings, actions, ideas and values. Agreeableness is caring, friendly, warm and tolerant behaviors, with the facets of trust, straightforwardness, altruism, compliance, modesty and tender-mindedness. Last, conscientiousness is individual differences in responsibility and persistence and is overarching to the six facets of competence, order, dutifulness, achievement-striving, self-discipline and deliberation (McCrae & Costa, 2003).

No particular theory is seemingly attached to the FFM. With personality trait models that stem from the lexical hypothesis , i.e., that were derived from natural language, the resulting models are strictly phenotypic or descriptive (Paunonen & Hong, 2015). No causal assumptions about the origin of personality traits need to be made to use the factor model or its measurement (Saucier & Goldberg, 1996). The use of the FFM will be considered descriptive (Revelle, 1987; Revelle & Condon, 2015), unless else is stated by the researchers who use it. As such, the methodological suggestions that I make about how to study individual differences in teams are not dependent on a particular theory about individual differences, but will apply to all trait-like constructs. Something that, as opposed to theory, *is* inherent in personality trait research is measurement and psychometrics (see e.g., Borsboom, 2005; Furr, 2011). The recognition of personality traits as unobservable and latent constructs has made necessary measurement- and analytical techniques that address and incorporate this nature of personality traits. Observed scores in personality assessment is always associated with measurement error (Viswesvaran & Ones, 2000).

The problem of levels in research on individual differences in teams

An aim of this dissertation is to investigate how personality can be studied in relationship to team level concepts with individual differences maintained. In summary of the above reviews of team- and personality research, the two disciplines differ in their theoretical claims. Team research draws on system theory (Arrow et al., 2000), whilst personality trait research is strictly descriptive or phenotypical

(Revelle & Condon, 2015). Perhaps the only throughout theoretical claim in personality trait research is that personality traits are individual differences (e.g., Paunonen & Hong, 2015). Another difference between team- and personality research is that the unit of study is not the same. The *focal unit* of study is the entity that one wishes to make generalizations about (Mathieu & Chen, 2011). As described above, personality research studies individuals at several levels, without changing the unit of analysis. That is, individuals are consistently studied. But in team research, individuals are only individuals at one level that is subordinate to teams, which in turn is a different unit.

For an example, imagine we study the effect of neuroticism on math exam performance. We can choose to study the mere correlational relationship between the variables, and would then find out how strongly neuroticism in individuals relates to math exam performance. Let's say we then divide the sample into groups of men and women. Now we can study the effect of neuroticism on math exam performance in two groups. This relationship is still at individual level, since men and women are two groups, or populations, of individuals. Next, we randomly divide the whole sample into small groups of three individuals per group. We then test the effect of the average neuroticism score per small group, on the average math exam performance per small group. The statistical treatment of data to study the small group averages of each variable respectively, is perfectly simple and straightforward. Yet it changes what it is that we study. We still can look at the relationship between neuroticism and math exam performance, but what that relationship applies to has changed. We no longer study individuals, but we study small groups of individuals. That what we say something about, with our generalization about neuroticism and math exam performance, is now small groups. Individuals and small groups of individuals, like teams, are not the same entity, or unit of analysis.

The example is not applicable to teams, since math exam performance is not a team level variable, but an individual level one. A team adapted example could be that we wanted to study the relationship between neuroticism in team members, and team productivity. To study this relationship, involving neuroticism and a team level variable, our individual level personality trait variable must somehow be related to the team level variable. The most common method to achieve this is to calculate the average of the individual level variable per team (Klein & Kozlowski, 2000). Again, this will change the entity that is studied; it will be a different unit of analysis. This is the core of the problem when individual differences and team research is combined- the change of entities or units. It brings about challenges for the study of personality and individual differences in teams. It however also brings about many unexplored relationships that are possible to study, if the individual level is insisted on as the focal unit of analysis.

As has been implied above, personality research and team research are rather different from each other and as a result, pose a special case of a problem. The

problem is again very visible in the definitions of respective topics. Personality is individual differences (e.g., Paunonen & Hong, 2015), and teams are two or more individuals who interact interdependently to reach common goals (Baker & Salas, 1997). Still, various personality traits have been studied in numerous studies as if they were traits of teams. Here, I take a slightly different view. Of course, personality traits like extraversion or neuroticism can be studied as if they are traits of teams instead of traits of individuals. Such studies are about variables. The problem I aim to point out is not about variables but about the entities that are studied.

The issue of shifting entities, or units of analysis, is something that many researchers in psychology do not have to consider. That is because units of analysis and variables of interest so often coincide in psychological research. Most often, each data point is a score that represents an individual's standing on a particular variable. But when personality in teams is studied, the score that represents one individual is not a data point that represents the team's standing on a particular variable. To represent teams, scores from two or more individuals that work in teams together must be transformed, i.e., assembled team by team in some statistical manipulation. Had the individual differences quality of a personality trait variable been prioritized over the variable's conceptual meaning, this change of data would have been counterproductive. In this way, research on personality in teams is akin to the choice between the variable centered approach and the person-centered approach. The variable centered approach is a focus on the relationships between variables, often with the purpose to predict effects of independent variables on dependent ones (Howard & Hoffman, 2018; Muthén & Muthén, 2000). The person-centered approach focuses on relationships among individuals and how similar or different they are from each other, given their standings on variables. The aim is often to create categories or study subgroups of individuals (Howard & Hoffman, 2018; Muthén & Muthén, 2000). The person-centered approach can also simply refer to research in which persons, rather than contexts, are studied (Woo et al., 2018). In this dissertation, I refer to the person-centered approach to attempt to study persons or individuals that are organized in teams. As such, person-centered means the priority of individuals over the team unit of analysis.

In the following, I will address that units of analysis is a dimension of data that can be thought of, maybe not in separate from variables, but next to them. To illustrate this, I will use Cattell's data box.

Cattell's data box

Cattell's data box, or cube, illustrates the three dimensions of data. The three dimensions are variables, entities (or persons, or subjects), and measurement occasions (Cattell, 1952). Cattell did present it in the context of exploratory factor analysis, but the dimensions of the box can be applied to any data regardless of the analysis that has been planned for it. Little (2013, p. 227) wrote that Cattell introduced the data box to help researchers "think outside the box".
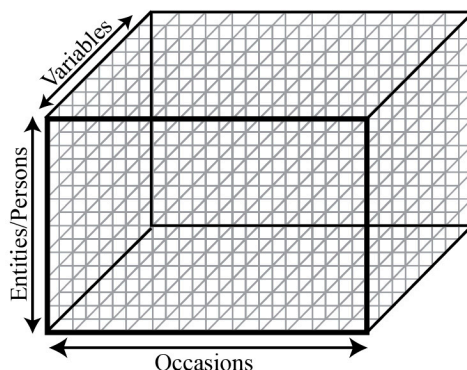
Figure 2. Cattell's data box

Note. Reprinted with permission from Todd D. Little.

Cattell's data box is depicted in Figure 2. The three dimensions of the box apply to a data matrix. A data matrix has rows and columns. The rows contain the observed data records and the columns contain the things that a researcher wants to study relationships among. The three dimensions can be shifted around, so that the box "rotates", and let any of the three dimensions be organized in terms of rows or columns. Cattell named the different setups of the data box that can arise when dimensions are shifted around, with letters. With R-techniques, variables are in the columns and persons or entities in rows. This is the setup in variable-centered designs and the dominant one in social sciences (Howard & Hoffman, 2018). It is used when associations or relationships between variables are studied, e.g., when the effect of a variable on another variable is studied, which in turn is information about the persons or the entities in the rows (Little, 2013). Examples of statistical analysis that is used for R-techniques is regression, structural equation modeling and factor analysis (Muthén & Muthén, 2000). With Q-techniques, persons or entities are in the columns and variables are in the rows. This is the case with the person-centered approach. The purpose of this setup is to find similarities among persons or entities in a given sample, in terms of their variable scores. The purpose can also have further steps, so that the first step is to identify subgroups and then to understand the relationships of these subgroups with predictors, correlates and

outcomes (Howard & Hoffman, 2018). Examples of statistical analysis that does this is cluster analysis, latent class analysis, mixture models and growth curve modeling (Howard & Hoffman, 2018; Muthén & Muthén, 2000; Sterba & Bauer, 2010). Last, with P-techniques, occasions are in the columns and entities are in the rows of the matrix. This setup has also been called "person-specific approaches" (Howard & Hoffman, 2018) and result in a context for time-series modeling. That means that the occasions are of interest so that e.g., the effect of a person's standing on a variable, like mood, one day, can be related to the same person´s mood the next day. Samples for this study design are often very small, not unusually it is one person. Data is analyzed across occasions, with the purpose to make inferences about the individuals in the rows. Typically data is collected at many occasions and examples of analytical techniques are time series modeling and dynamic factor analysis (Howard & Hoffman, 2018; Little, 2013).

In this dissertation, I suggest that the person-centered approaches, the q-techniques, would be worthwhile to draw on and integrate to avoid changing the unit of analysis when individual differences are studied in teams. That is, to study individuals in teams in terms of subgroups across team clusters.

The options for selecting methods to treat data have been detailed by both Howard and Hoffman (2018) and Sterba and Bauer (2010), and the options are outlined in two steps. First the suitable approach must be selected; variable-, person or person-specific, which correspond to the dimensions of Cattell's data box. This choice largely depends on the research questions and hypothesis that researchers ask. Secondly, a data analysis technique is decided on, based on specific matters of data and hypothesis. Howard and Hoffman (2018) stress that the first decision, on what approach to choose is overarching to the specific analysis techniques that are chosen in the second step, and that the choice of approach must also be guided by theory. Sterba and Bauer (2010) on their side, stress that approach and analysis technique is not synonymous- once it has been decided what approach is most suitable for a given hypothesis and data set, various analysis techniques must still be chosen from. In summary, the fine-grained decisions that researchers make about analysis techniques are only secondary to the overarching methodological approaches that are illustrated in Cattell's data box.

The three dimensions in the data box are not mutually exclusive, but each one of them are one aspect of data. Therefore, the person/unit-dimension is found in all three descriptions of the different approaches. Little (2013) described that in R-techniques, the variable approach, the persons- or entities are what the variable relationships are about. Now, if we switch the unit of analysis in the entity dimension, and trade people for small groups of people, that *may* be consequential to the inference that can be made. This is because it is a change of one dimension of data that is entangled with the other two dimensions.

Specificity. Howard and Hoffman (2018) describe that the variable centered approach is the least specific but most parsimonious of the three approaches. It is the most parsimonious since most often, the result is only one set of parameter estimates, which makes it the easiest to interpret. It is however the least specific because the result describes the whole sample together, so that an effect of a variable on another one is summarized in one average effect for all subjects. The specificity may lessen with shifts of units on the person/entities dimension. When individual differences are modeled at team level, the parameter estimate of an effect of one variable onto another is still the average effect across all entities. But additionally, the entities themselves are statistical summaries of individuals within their team clusters. This must by necessity make specificity lesser, if individuals are a unit of interest.

Individual level assessment

Neuman and Wright (1999) wrote that researchers tend to choose to study personality at one or the other level. They noted that it is the level of the criterion, or the outcome variable, that determines that level. When the outcome is at team level, e.g., monthly production rate of teams, personality will commonly be statistically accumulated in team clusters and become team personality composition. LePine et al. (1997) wrote that aggregation is necessary to account for intelligence- and personality scores in teams. This issue is not always the case when individuals are subjected to research at more than one level. For an example, when school children and their school performance are studied. Schools, regions and countries can be different levels of analysis, but the outcome is still at the individual level; children's school performance. In such cases, individual differences can be studied at individual level. In team research, outcomes are however often at team level.

Team processes too are in most cases aggregates (Bell, 2007; Quigley et al., 2007). The most common method of assessing team processes is to survey individual team members about team processes (Klein & Kozlowski, 2000), and aggregate responses to the team level. Team process scales can be adapted with referent shifts (Chan, 1998) to assess team processes. With referent shifts, items are altered so that the unit of inquiry is the team, e.g., "I have confidence in myself", would be altered to "The team has confidence in itself". Arthur Jr et al. (2007) showed that referent shifts did improve the accuracy of the team level assessment. Furthermore, indices to assess the reliability and validity of team level concepts have been developed. One of the most frequently used is the intraclass correlation (e.g., Bliese, 2000; Chen et al., 2005; Shrout & Fleiss, 1979). An intraclass correlation is the proportion of team level variance compared to the total variance of a dependent team process variable. Taken together, the assessment level of team processes highlights a complex side of the multilevel nature of teams. Namely, theory, measurement and analysis are all involved when multiple levels are involved, but they do not

necessarily all occur at the same level. Rousseau (1985) presented a framework for this in which he suggested that both theory, measurement and analysis must be considered when dealing with multilevel constructs. Often, the measurement or assessment level is in common to personality- and team research, but not the theory- and analysis level.

Team level operationalizations of personality

In Figure 3, the most common team level operationalizations of personality in teams are depicted. The most common one of them is the mean (Halfhill et al., 2005), but e.g., Bell (2007) used all four in her meta-analysis. What follows is a brief examination of how the individual as the unit of analysis is lost in operationalizations of personality at team level.

Team level

M, Var
Min, Max x ⟶ y

X X X

Individual level

Figure 3. Team level operationalizations of personality

Note. The y at the team level symbolizes a team level outcome variable. The individual level x:es symbolize personality trait scores. The team level x symbolizes one of the four team level operationalizations that can be selected; M=mean, Var= variance, Min= minimum, Max=maximum.

As seen in Figure 3, there are four common ways of operationalizing personality at team level. They are the team mean, the team variance (sometimes the standard deviation is used), and the minimum or the maximum score from a team (e.g., Bell, 2007; Halfhill et al., 2005). With the team mean operationalization, the average of team members' scores on some trait represents the team personality composition. Hence, neither the score per individual team members or differences between individual team members are maintained at the team level. With the variance operationalization, the average team member deviation from the team mean represents the team personality composition, and again scores of individuals are lost. However, the variance operationalization is arguably closer to represent individual differences than the mean is, since it represents the within team variability. Still, the variance presents a local average deviation, since the deviation is from the team mean. In studies of individual differences, the mean from which individuals deviate

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is a population or population sample mean. This difference is directly related to the unit of study. The team personality variance operationalization is based on the team mean, and so the team is arguably the unit of analysis. The minimum and the maximum operationalizations use only the lowest or highest scoring team member on some personality trait to represent personality at team level. These operationalizations indeed represent individual level personality, but the differences between individuals in teams are not assessed since only one team member score per team is selected. Expressed differently, the individual level scores represent teams but only contain one member, which is not congruent with any team definition.

The entity problem of team personality operationalizations is not resolved with multilevel modeling. This analytical framework allows researchers to study variation at more than one level simultaneously. Thereby, we can partial out variance at different levels, e.g., the individual- and the team level (e.g., Nezlek, 2011). Although this increases the sophistication of data analysis, and power (Snijders & Bosker, 2011), the options to model personality at the team level changes the unit of analysis. For an example, team level random intercepts correspond to the team mean operationalization in models with no covariates (e.g., Silva et al., 2019). Another example of a modeling option that adheres to team units is group mean centering. Group mean centering leaves only the within team variability at the team level of analysis (Enders & Tofighi, 2007). So, although more than one level of analysis is possible with multilevel modeling, it employs an aggregating mechanism to account for team clusters.

For a last note on team level operationalizations; several authors have recognized that the meaning of one and the same concept may be different when it is modeled at more than one level (Snijders & Bosker, 2011; Stapleton & Johnson, 2019). Personality is perhaps a special case of this. Since the very definition of personality traits is individual differences (Paunonen & Hong, 2015), the meaning of the concepts changes in a concrete manner when the unit of analysis changes. Next, I will suggest how the change of study entitles can be circumvented, so that individual differences can be applied in team constellations.

Personality as individual differences in team constellations

To keep individual's personality trait scores untransformed when they are placed at the team level of analysis, we can use individual level, team relevant, markers. In two of the studies presented in this dissertation, I use team roles as individual level markers. Team roles integrate the entity- and variable dimension of data, which lets us avoid a shift of analysis unit. Figure 4 illustrates how team role subgroups let several team members' trait scores, or team perception ratings, be used at the team level. Each team role in the picture represents a subgroup of individuals from the sample, in particular team roles. This makes possible for us to study trait scores of

individuals in the different subgroups in relationship to team level variables. We could also relate members of same teams to one another, e.g., with interaction terms.
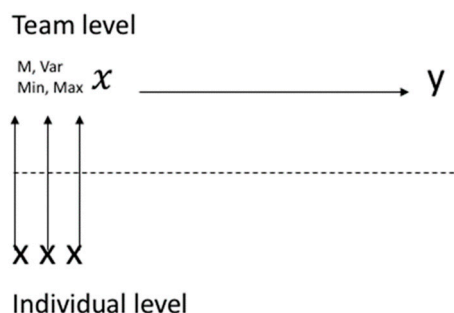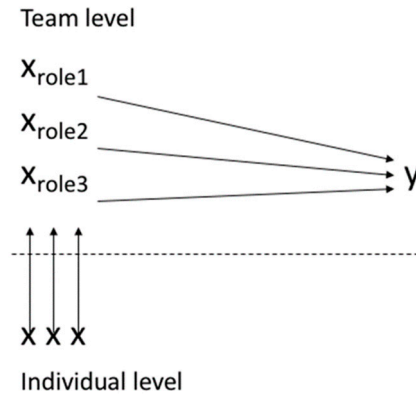

Figure 4. Team level operationalizations of personality by role subgroups

Note. The y at the team level symbolize a team level outcome variable. The individual level x:es symbolize personality trait scores. The team level x:es symbolize the same trait scores separated by the team role that each individual team member has.

Team roles are not new in team research. In the work of McGrath (1964), roles are integrated into the system perspective on small groups and teams. Also in the work of Kozlowski and Ilgen (2006), team roles are part of the definition of teams. Katz and Kahn (1966) wrote that roles are the most important link between the individual and the organizational levels. Personality has been linked to role behavior, e.g., Mumford et al. (2008) reported that e.g., agreeableness was positively related to social role behavior. Personality in team roles has also been linked to team effectiveness. Stewart et al. (2005) too reported that agreeableness was positively related to social role behavior. Furthermore, when both task and social roles were aggregated in teams, they had relationships to team processes (social cohesion) and team performance. In some team studies, roles have been used, or suggested to be used, to investigate within team variability (DeRue et al., 2010; Humphrey et al., 2009). Such work is advancements of team level analysis that addresses the meaning of within team variability. Within team variability however take the team level for a unit of analysis, and is motivated by team level theory. My aim is instead to begin at the individual level to take individual differences into consideration. I therefore apply roles to enable the use of individual level variability in relation to team level outcomes. Roles in my studies are a methodological means to study subgroups across teams, without transforming or changing individual's trait scores. As such, roles are a methodological rather than theoretical approach.

In practical terms, roles will be categorizations of individuals, so that one person from each team is in a particular role group. This way, subgroups can be formed

based on a categorization that is relevant to the team level, yet allow for analysis with the individual as the unit of analysis. Personality trait scores in the analysis will be scores of individuals, organized in team role groups, but untransformed, i.e., not statistically accumulated by team membership. This is akin to the person-centered approach, though subgroups are not found in analysis, but subgroups are used to test the effect of personality on team level outcomes. Without the role subgroups, the team structure will be the grouping category of the data. The subgroups I suggest relate to the predefined cluster structure that data come from; teams. The suggestion draws on the person-centered approach rather than the variable-centered approach because it integrates persons in the entity dimension of data. The integration of persons matter since the predefined team cluster structure alone would prioritize variables in the data setup.

Two versions of how to use team roles to assess individual differences are proposed in the dissertation studies. First, I use team roles to keep personality at the individual level of analysis. Then I use team roles to introduce team processes at the individual level of analysis, i.e., to consider team processes individual differences.

Are team processes individual differences? The possibility of construct overlap

The other application of personality trait research in teams, that I suggest, is to study the content overlap to team processes. Team processes theoretically belong to the team level, but could contain variability that is personality in individual team members. Research rarely addresses the relationship between personality and team processes at the individual level, at which both are assessed. My suggestion is that instead of treating team personality composition as predictive of team processes, we test whether team processes are confounded with individual's personality traits. That is, instead of letting team personality predict team processes, the relationship between variables can be studied at individual level. Because after all, it is known that aggregated data often are inflated estimates of lower level relationships (Klein & Kozlowski, 2000; Robinson, 1950; Thorndike, 1939). This is closely related to the ecological fallacy.

The ecological fallacy is about interpretation of relationships from different levels of analysis and stems from the work of Robinson (1950). He demonstrated that relationships between variables from aggregated data of individual behavior are not the same as the relationships of the same data at individual level. When individual level data is aggregated to groups, error variance that potentially represents individual behavior is removed. A potential example of this is presented in Figure 5. The correlational relationship at individual level, $n=70$, is $r=-.415$, and the correlational relationship at team level, $n=25$, is $r=-.739$.
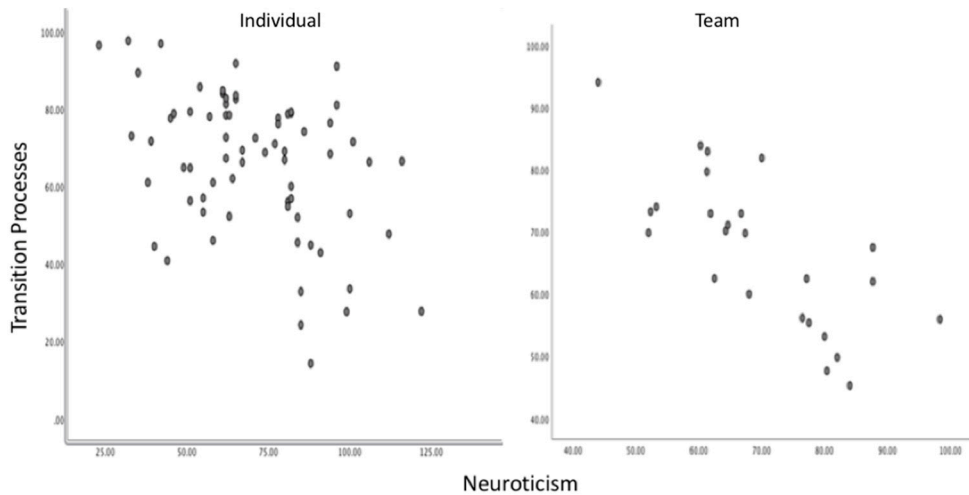
Figure 5. A potential ecological fallacy. Correlation is based on the individual and team level relationships between transition processes and neuroticism.

Note. The correlational relationship at individual level, left picture, n=70, is r=-.415, and the correlational relationship at team level, right picture, n=25, is r=-.739. Data is from Study 1.

Robinson concluded that group aggregated data cannot be used to study individual behavior. But this only applies when both variables in a relationship are aggregated from the individual level. With one group level variable and one individual level variable, researchers has no choice but to aggregate data to the group level (Langbein & Lichtman, 1978). With team personality composition and team processes, both variables are at team level in the statistical models. Meanwhile, they are both most often measured at the individual level. Hence, a researcher's preferred level of interpretation may be competed.

Team processes are conceptually at the team level, i.e., team processes can't take place in individuals but only in teams. The measurement of team processes is however individuals' perceptions of their teams, assessed in self-ratings (Quigley et al., 2007). And so, in the analysis of team process data, it can be tested whether team processes to a meaningful extent is lower level, individual, trait variability. For an example LePine et al. (2011) have addressed the relationship between personality in individuals and their team process ratings. They see the relationship in terms of the IPO -model, i.e., as if personality causes team behavior in individuals. I do not mean to say that that is inaccurate, but I suggest that some conceptual overlap is reasonable. Prediction is not the only possible relationship between personality and team processes, but also measurement overlap is possible. Given the many tested predictive relationship in previous studies, the possibility of measurement overlap seemingly has not gained attention. Still, when personality trait variability conceptually overlaps with team process ratings, it will affect team level statistical

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accumulations of personality- or team process scores. If the construct- or measurement overlap is large enough, it can be a validity threat to team processes at team level.

My point is not statistical, yet has consequences for the statistical treatment of data. Data has three dimensions; variables, entities and measurement occasions (Cattell, 1952). Both personality- and team research tend to take a variable-centered approach to data. But, in another dimension of data, the entity dimension, they inherently differ. The two research fields study different entities. In the three following studies, the individual entity that is subordinate to, but also form the team entity, will be the focal unit. I aim to exemplify how individual differences and personality can be studied and applied to enhance our understanding of team constellations.

Methodological overview

Data

The data comes from a longitudinal research project about new venture teams, "The Swedish Longitudinal data on New Venture Teamwork" (Brattström et al., 2020), and the author has been involved in the data collection.

The research project that resulted in "The Swedish Longitudinal data on New Venture Teamwork" was funded by the Swedish Research Council and Handelsbanken. The new venture teams in the study responded to two different surveys; one about team processes, that team members took individually, and one about new venture progression, that was responded to by one team member only. The survey about team processes was administered to all participants every three months during their year of participation, and the new venture progression survey was administered to the one respondents per team every six months. The data was collected with a planned missing design (Little & Rhemtulla, 2013; Little et al., 2013), which means that only some of the items from the scales were presented to participants according to a random pattern. The resulting missing data is missing completely at random (MCAR).

The personality data, I have collected from a subsample of the respondents in the larger project that resulted in "The Swedish Longitudinal data on New Venture Teamwork".

Participants

The participants were all members of new venture teams that were enrolled in business incubator programs. The business incubators in the data collection were located in Sweden, Denmark and Russia. The whole sample in the overarching research project consisted of 877 surveys from 270 individuals in 117teams.

In *Study1,* a subsample of 270 responses to the team processes survey, from 70 individuals in 25 teams was used. The selection in the subsample was based on what participants had both taken the personality test and filled in the survey about team processes at least twice, and that at least two members from the same team had done

so. Participants' mean age was 34.68, *SD*=10.21, and 25.7% of the participants were women. On average, each participant responded to the team process survey 3.86 times, *SD*=1.62. The average number of responses per team was 10.80, *SD*=7.94.

Study 2 was cross sectional and the sample consisted of 78 individuals in 39 teams. This was a subsample of the larger data set. Participants that were selected were the ones who had taken the personality test and that had clear enough role descriptions to be called either chief executive officer (CEO) or chief financial officer (CFO). The average age of the ventures was 31,17 months, and the age of the individual participants ranged from 23 to 74 with a mean of 37,65. In the sample, 79 % of the participants were male.

In *Study 3* the data was longitudinal and consisted of a new subsample from the research project data. The 192 survey responses about team processes were nested in 99 individuals and 46 teams. Apart from having taken the team processes survey, a selection criterion when the subsample was created was that participants must occupy one of three team roles; leadership, business- or product development management. On average, each of the 99 individuals responded 2.01 times, *SD*=1.05. Thirty-five of them responded only once and four responded five times. For the 46 teams, an average of 4.52 responses per team, *SD*=2.82, were in the data. The average age of the participating new venture teams at study entry was 2.42 years, *SD*=2.10.

Measurements

Personality. Personality was measured with the Swedish version of NEO-PI-R (Costa & McCrae, 1992). The inventory measures the five factors: Neuroticism, Extraversion, Openness to experience, Agreeableness and Conscientiousness with 240 items. Each item was rated on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree".

Throughout the studies, five team processes scales were used. They are listed below.

Transition processes. Transition processes were assessed with the scale that Mathieu et al. (2020) developed, using the three items selected by the scale authors for a shorter version of the original scale. Responses were given on a sliding scale ranging from 0 to 100, with response values "never" to "always".

Action processes. Action processes were also assessed with Marks et al. (2001) scale, again using the three items selected by the scale authors for a shorter version of the original scale. Responses were given on a sliding scale ranging from 0 to 100, with response values "never" to "always".

Transactive Memory Systems. Transactive Memory Systems (TMS) were assessed with Lewis (2003) scale, of which two items from each subscale were used. The three subscales are called Specialization, Credibility and Coordination. Responses were given on a sliding scale ranging from 0 to 100, with response values "disagree" to "agree".

Task interdependence was measured with four out of the six items in the scale by Wageman and Gordon (2005). Responses were given in a sliding scale response format, where subjects rated responses from 0 to 100, with response values "disagree" to "agree" or "never" to "always".

Team viability was assessed with the Aston Team Performance Inventory Team viability scale of three items. Responses were given in a sliding scale response format, where subjects rated responses from 0 to 100, with response values "disagree" to "agree" or "never" to "always".

Product development progression, that was used in Study 2, was measured on a scale from 1 to 5, where 1 represented "A mock-up exists", 2 "A working prototype or procedure has been developed", 3 "A prototype or procedure has been tested with customers", 4 "The product or service is ready to ship to customers" and 5 "Customers say service is complete with no missing features".

Customer advancement was a covariate to represent the new venture creation process over time in Study 3. The variable was assessed in four consecutive response values; Prospect, Qualified prospect, Committed and Transacted.

Procedure

For the recruitment of participants, business incubators were approach. Contact with new venture teams then took place through business coaches and administrators. Teams in which at least two team members were interested in participating were enrolled in the study. Surveys were administered to participants through e-mails with survey links to a Qualtrics platform. Reminders to fill in surveys were sent once a week for three weeks. In the case of the survey about new venture team progression, participants could either fill the survey in themselves or chose to be interviewed by a researcher. By the first occasion that respondents filled in the survey about team processes, also demographic questions and questions about professional background were asked. The survey took approximately 35 minutes to fill in the first time and 25 minutes the consecutive times. The additional survey about new venture progression was administered at study entry and every six months, i.e., three times. This survey was filled in by one team member only, with insight in the venture progression.

Summary of studies

Study 1

Background and aim

The aim of this study was to study the relationship between personality traits and team process ratings at the individual level. In many studies, personality has been adapted to the team level of investigation and hypothesis testing by aggregation to the team level (e.g., Bell, 2007; LePine et al., 2011). In accordance with the theoretical framework in team research, the input-process-output (IPO) model (Marks et al., 2001), team personality predicts team processes. In Study 1, it was demonstrated how it instead can be tested whether individual level personality predicts team process ratings i.e., whether team processes have a personality trait component.

Content overlap between psychological concepts have been studied for decades (e.g., Ashton & Lee, 2018; Campbell & Chun, 1977; Gannon & Ranzijn, 2005). But measurement overlap between personality scales and scales that were designed to assess concepts at team level has not yet been evaluated. The potential overlap between personality and team process measurement is perhaps not theoretically intuitive. Personality and team research study variables that apply to different units of analysis. However, both personality and team processes are most commonly assessed in individuals. That is, also when team processes are assessed, that theoretically cannot occur in individuals themselves, it is individuals who respond to the measurement scales about team processes (Klein & Kozlowski, 2000). Three team process scales with broad reach in team research were selected, and related to the personality traits agreeableness and conscientiousness. These two traits were chosen because of their respective work- and sociability connotations (e.g., Barrick & Mount, 1991; Jensen-Campbell & Graziano, 2001), which may form content overlap with the taskwork and collective goals of team processes (Marks et al., 2001). For a nuance of the content overlap between personality traits and team processes, it was also suggested that relationships between individuals' personality and their team process ratings can be due to sensitivity to team process perceptions. This was addressed with tests of relationships between team process ratings and neuroticism.

It is well known in social sciences that aggregated data often result in inflated estimates of lower level relationships (Klein & Kozlowski, 2000; Robinson, 1950; Thorndike, 1939). It is this problem that was addressed in Study 1. To address this problem, it must be investigated if team processes contain meaningful individual level variability, i.e., whether team processes contain individual level personality trait components.

Method

The sample consisted of 270 team process responses nested in 70 individuals and 25 teams. Personality was assessed with the 240-item Swedish version of the NEO-PI (Costa & McCrae, 1992). The team processes used were Transition- and Action processes (Mathieu et al., 2020) and Transactive memory systems (Lewis, 2003).

The team process scales were shorter versions of their original scales and the data was collected with a planned missing design (Little & Rhemtulla, 2013; Little et al., 2013).

The relationships between all three of the team processes and agreeableness, conscientiousness and neuroticism were estimated as nine separate relationships. This was first done with bivariate correlations, with individual's trait scores and mean aggregates of their repeated team process responses. The same relationships were then studied in multilevel structural equation models (MSEM) (Muthén & Muthén, 2017). The repetition of analysis in the MSEM framework was to control for the team level variability that the team process scales are designed to measure, and to manage the planned missing data structure with full information maximum likelihood (FIML) estimation. Furthermore, the change of intraclass correlations, ICC(1), was assessed to investigate whether the introduction of personality traits at the individual level decreased the team level variance, which would indicate that team process variance at the team level could partly be inferred from personality at the individual level.

Main findings and conclusions

The results indicated sizable relationships between conscientiousness and two of the three team processes at individual level, but no relationships were found for agreeableness at individual level. Neuroticism had moderate or large relationships to all of the three team processes at individual level. Furthermore, the team level variance proportion did show a decreasing trend when personality traits with significant relationships to team processes were introduced. The results together indicate that there is a personality trait component in team processes at individual level and that it tends to affect the information that is available at team level.

It was discussed how the test of individual level relationships between personality and team processes alters the understanding of the team level relationship between personality and team processes as it is stated in the IPO model. For if team processes have personality trait content at individual level that is not controlled for, personality trait content may aggregate at team level. As such, the team level relationship between personality and team processes will be affected by the overlapping construct content, or the shared personality variance between them. This overlap, that comes with the threat of causing inflated higher-level relationships, can only be detected when individual level relationships are investigated at the same time as the higher-level ones. Therefore, it was suggested that personality could be used to evaluate team process measurement at the individual level, rather than to predict team processes at team level.

Study 2

Background and aim

The main purpose of Study 2 was to elaborate on how individual level personality can be related to team level outcomes. The goal was to draw on both the theoretical individual differences background of personality traits (Chamorro-Premuzic et al., 2015; Paunonen & Hong, 2015) and the interdependence of team members (Courtright et al., 2015) that would motivate the aggregation of personality scores in teams. The use of team roles was suggested as a means to fulfill this goal, by forming subgroups of individuals. Subgroups of individuals according to team roles allow for testing relationships between individuals and team outcomes, yet the subgroups are based on team membership.

To consider the dependence of team outcomes on more than one team member, previous studies has often aggregated personality trait scores to the team level (e.g., Barrick et al., 1998; Bell, 2007; LePine et al., 2011). In Study 2, a sample of new venture teams was used. Previous studies on personality in new venture teams are few, but e.g., Zhou et al. (2015) have studied personality composition in new venture teams. The other common way by which personality has been related to team level is with personality in the team leader (e.g., Aronson et al., 2006; Peterson et al., 2003). With the leader's personality related to the outcome, the level of measurement does not change from the individual to the team level. Trait scores from only one individual does not necessitate a team level operationalization. The suggested means by which personality in individuals can be related to team level outcomes, formal roles, was an extension of the use of the leadership role to several roles. Roles have been called the most important link between the individual and the organizational levels of study (Katz & Kahn, 1966; Stewart et al., 2005).

However, apart from maintaining personality scores at the individual level of analysis, while several team members scores can be related to team outcomes, the assignment of team roles to individual team members also opens up to further study the interdependence of team members. By testing interaction effects between team members' personality traits, according to their roles, it can be assessed whether individual team members influence team outcomes in an interdependent manner. Meanwhile, main effects of some single role would weaken the interdependent assumption. The test of interaction effects between team member's personality traits has previously been proposed by Hogan and Ahmad (2011).

It was illustrated how team data must be restructured to enable analysis with subgroups of individuals by team roles. To exemplify the use of roles to study individual differences in relation to team level outcomes, it was tested if personality in chief executive officers (CEOs) and chief financial officers (CFOs) seemed to have different effects on product development.

Method

Data was cross sectional and the sample consisted of 81 individuals of which 39 were pairs of CEO and CFOs from the same teams. Personality was measured with the 240 item version of NEO-PI-3 (Costa & McCrae, 1992). The dependent variable, product development progression, was measured on a scale from 1 to 5, where 1 represented "a mock-up exists" and 5 "customers say service is complete with no missing features". The relationship of CEOs' and CFOs' personality traits, in separate and in interaction, was tested with ordered logistic regression. One model per the five assessed personality traits was estimated, first with main effects only and then including interaction effects. Venture age was a covariate in all models to control for the progression effect of time since ventures were founded.

Main findings and conclusions

Since the aim of Study 2 was to elaborate on how personality traits can be kept on an individual level of analysis and still related to team level outcomes, the result of the analysis in the study served as an example of how personality differences in teams can be assessed at individual level. No claim of empirical rigor was made, but through interpretations of the results, the access to the workings of individuals' personality differences was demonstrated. For an example, the CEO and CFO level of neuroticism was related to product development with different directions. Although only the CFO relationship was significant, relation between one or the other role occupant with product development would have been masked with a team aggregation of the CEO and CFO trait scores. Another example with CEOs level of neuroticism, was that the relation between CEO neuroticism and product

development was about the same size as the relation between CFO extraversion and product development. In the leadership tradition, only the effect of the CEO would have been studied. It was argued that our understanding of personality in teams may be limited if only one leader per team is studied. Last, only one interaction effect out of the five tested was significant.

In study 2, it was concluded the use of roles to study personality in different individuals in teams, can open up to a better understanding of whether personality traits per se, or personality in individuals affect team outcomes.

Study 3

Background and aim

In Study 3, no personality traits were studied. However, the individual level of team processes was. The most common method to measure team processes is to ask survey questions to individual team members (Klein & Kozlowski, 2000). Since team processes are designed to measure processes at team level, team member's scores are aggregated to the team level (Quigley et al., 2007). After all, team processes can't take place in individuals but in teams. Consequentially, the individual level variability, or the team member's deviation from the team means, are considered measurement error (e.g., Chan, 1998; Stapleton et al., 2016). It still is individuals who answer questions about their teams though, and so it is possible that team process perceptions are affected by the role that team members have. This possibility was studied in Study 3. The aim was to investigate whether the individual level variability of team processes would be meaningful to understand team processes in new venture teams. What specifically was studied, was whether team processes developed differently for leaders, business- and product managers over the course of new venture creation, in a sample of new venture teams.

Entrepreneurship research has for long been centered around individuals (Foss & Lyngsie, 2014), but a clear trend of researching teams instead of individuals is evident (Klotz et al., 2014). Individuals and teams are not the same unit of study (Mathieu & Chen, 2011). Therefore, it may be especially important to entrepreneurship research, where both individuals- and team can be studied, to know whether individual level team process variability is only just measurement error, or a source of crucial information. This was tested in Study 3, again with team roles as individual level factors. Because roles, as mentioned in the description of Study 2, are an important link between individuals and their organizations (Katz & Kahn, 1966), which in this sample is new venture teams. That is, they separate individuals within teams, but also are related to teams.

Method

The data was longitudinal and consisted of 192 survey responses nested in 99 individuals and 46 teams. On average, each of the 99 individuals responded 2.01 times, $SD=1.05$. For the 46 teams, an average of 4.52 responses, $SD=2.82$, were part of the sample. The average age of the participating new venture teams by the time the study started was 2.42 years, $SD=2.10$. Out of the 99 individuals in the sample, 40 had leadership roles, 26 had roles in the business category and 33 had roles related to product development.

To investigate whether the individual level variability of team processes is more than measurement error, i.e., differ according to team member's roles, four different team processes were used. Statistical tests were performed separately for each team process in multilevel models. To model the new venture creation process, or time, customer advancement was a covariate in the models. This variable assessed how far each team had reached in their establishment of relationships with customers. The main focus of the analysis was team roles, and whether team process developments differed between roles.

Main findings and conclusions

The results indicated that team processes do differ over time depending on which team role new venture team members have. Process ratings for both the product- and business roles differed from the leadership in at least one of the four team processes. One important consequence of this would be that if team processes are studied at team level only, an important source of information at the individual level may be overlooked. Furthermore, if differences between role groups are neglected, they may occasionally cancel out within teams so that no team level development is visible. The study findings would need to be replicated in several more studies before it can be concluded that the individual level team process variability is meaningful and should be accounted for to achieve accurate relationships.

Study 3 highlights an important tension between theory and measurement. Theoretically, team processes are clearly a feature of teams. But the measurement of team processes involves individuals from teams, which may introduce a systematic individual level impact on team process ratings. It can be tested whether there is such an impact with team roles. If team roles seem to have a systematic impact on team processes also in future studies, then they in turn open up to new theoretical advancements.

Discussion

What if individuals, and not teams, sometimes is the most important unit of interest in team research? The application of differential psychology and personality research in this dissertation poses an example of this. As cited in the introduction, Bell has stated that the study of personality in teams poses a complication: "composition variables pose a particular problem, because although individual difference variables are by definition at the individual level, the interest in team composition is in the unique combinations of individuals who compose a team, or how the individual level variables are combined to reflect a team-level operationalization" (Bell, 2007 p.598). Team composition, the combinations of individuals that are in teams, have been used in many previous studies of personality in teams (Emich et al., 2021; Halfhill et al., 2005; Humphrey et al., 2009; Wolfson & Mathieu, 2017). The use of team personality composition reflects teams as the main unit of research interest. In this dissertation, I have asked if we have to abandon the individual as a unit of analysis and interest to study team level processes and outcomes. That is, I ask not as Bell above, "how the individual level variables are combined to reflect a team-level operationalization", but if individual level variables can be directly related to team processes and outcomes. A key to this is to contrast the focus on variables with a focus on entities, or units, of interest- and analysis. These two different perspectives are two dimensions of data, illustrated in Cattell's data box (Cattell, 1952), and also in the variable-centered and person-centered approaches to data (Howard & Hoffman, 2018). In research about personality in teams, trait variables are studied not just in individuals, but in small groups of individuals that to some extent depend on each other (Arrow et al., 2000; Baker & Salas, 1997; Courtright et al., 2015). Therefore, both variables and what variables are applied to, are important aspects of the research. Teams have been the main unit of interest and analysis when personality has been studied in relation to team processes and outcomes (e.g., Barrick et al., 1998; English et al., 2004; Halfhill et al., 2005; Prewett et al., 2009; Zhou et al., 2015). There is a lack of studies with the individual as the main unit of interest and analysis, in relation to team processes and outcomes. In addressing this lack, I suggest approaches to study individuals across teams, yet in relation to the hierarchical structure that is present in data when we study teams.

Multilevel modeling increases in popularity (Eckardt et al., 2021). The increasing use of advanced statistical methods comes with greater statistical sophistication, and

possibilities to investigate more complex relationships. But it may also help reveal how we think about data. Often, the focus on variables does not pose a problem with regards to the other dimensions of data. However, with the topic of this dissertation; personality in teams, the entity dimension of data changes with the study of relationships between team variables. This happens when individual differences are statistically gathered into their team units. The change of entities could pass by unattended if the person/entity dimension of data is not explicitly considered next to the variable dimension.

Study examples

The three study examples each illustrate a different way of how individual differences can be kept and used in the study of teams. Since the dissertation purpose was to elaborate on how individual differences can be studied and be useful in research about team constellations, I describe the contributions of the respective studies in the following.

Study 1 exemplified a way of using personality to study the content overlap between personality traits and team processes, instead of the theoretical effect of personality on team processes. Both personality and team processes have most often been measured through self-ratings of individuals (Klein & Kozlowski, 2000; Paunonen & O'Neill, 2010), i.e., the measurement assessment level of both constructs is the individual level. That is, also team processes are assessed at the individual level, although team processes measurement aims to assess team level constructs. Due to the common level of measurement, content overlap ought to be studied at individual level. Study 1 as such exemplified how we can study the validity of team process measurement via individual's ratings. More content validity studies would help strengthen the use of team process variables when they are assessed in individual team members. Study 1 was furthermore an example of how longitudinal data would be used in personality research (e.g., Fleeson, 2001) rather than how it would be used in team research. That is, team process measurement occasions were averaged together per individual.

Study 2 illustrated a second example of how individual differences can be used in the study of teams. This time, personality variables were related to team outcomes, with the individual unit of analysis kept with the help of team role subgroups. The subgroups were created according to the roles that team members had. As opposed to Study 1 and 3, no team processes were used in Study 2. Instead, each model had two variables and two theoretical levels of analysis: personality variables at the individual level and new venture team outcomes at team level. (Team processes, that were measured at the individual level, but designed to assess team level concepts, served as a modeling link between the levels in the two other studies.) More

precisely, I restructured the data so that variable columns contained personality trait variables per the different role subgroups. This procedure integrated the individual entity and the personality variables so that each team was represented on only one row of the dataset. Assigning each individual to a role group is a categorization of individuals that is relevant to their work in their respective teams. It makes possible to relate personality traits at the individual level of analysis to team level outcomes with fixed effects. A different way to say this would be that the data box was rotated- the tests of effects took a starting point in the entity dimension of data, i.e., the example analysis was about subgroups of individuals instead of team clusters. Had personality traits been aggregated to the team level before they were related to team level outcomes, then the variable contents would rather have been the main subject of the analysis.

Study 2 was an example of how subgroups can be used to make it possible to analyze personality in groups across teams, instead of aggregating personality variables in team clusters. The example with roles relates to some of the analysis techniques that would be considered with a person-centered approach, only the subgroup analysis is backwards. That is, instead of performing analysis to achieve a subgroup solution, the division of subjects into subgroups takes place before analysis. Without the team role subgroups, the person-level of analysis would however not be accessible. The purpose of the subgroups is to separate the individuals that are in the same teams from each other, so that individuals can be related to the team outcome variable. In other words, the subgroups are applied to reach at persons in the sample, as opposed to teams. Or, it could be said, the subgroups of individuals in team roles are used instead of team groups. The exemplifying tests of effects aimed to understand whether the subgroup division of individuals was meaningful or not. I.e., if there for an example was a different effect of neuroticism in CEOs than for neuroticism in CFOs on the team or venture outcome. On top of this aim, interaction effects between members of same teams from the different role groups were tested. The interaction tests were performed to show how the interdependence of individuals in teams can be modeled when individual differences are studied.

Study 3 illustrated how team processes variability can be utilized both at individual- and team level. This was achieved through the assignment of new venture team roles to individuals, so that team processes trajectories in role groups (i.e., at individual level) could be studied along the course of a team level outcome; product development. The particular area of research that this example was applied to is of special interest for the idea to model team processes at both team- and individual level. New venture team research is part of the entrepreneurship field of research, that has a long tradition of studying individuals, i.e., entrepreneurs (Klotz et al., 2014). With new venture teams, the use of individual level roles opens up to many possible studies that can use findings from previous studies about individual entrepreneurs. For an example, previous results about personality in individual entrepreneurs (e.g., Brandstätter, 1997) can be tested in leaders versus product

managers respectively, as two separate groups who are interdependent on one another in teams. The combination of both individual- and team level variability has the potential to combine research about individuals and teams that to date indeed take place within the same field, but in separate studies. Study 3 is an example of how differences can be studied both in groups of individuals according to team relevant categories, and in team clusters simultaneously.

In study 3, no personality variables were used. It was however the aim of the study to show how individual differences can be useful also in terms of team processes. The individual differences meant in this study were differences at individual level of analysis, and not personality traits per se.

Although the three studies utilize various statistical analysis techniques, the problems that they address are not statistical ones. What is addressed in the three studies is how the entity dimension of data can be considered when data is analyzed, so that individual differences can be studied in teams. In other words, the problem that is addressed is not a statistical problem but how we think about data. That said, the terminology that we have at hand does not aid thinking of data in separate, or perhaps even in distinguishable ways, from data analysis. In the following, two pairs of concepts that are common when data and data analysis is dealt with will be discussed. The aim of discussing these terms is to help organizing the discussion that will likely be needed to understand the importance of the entity dimension of data. For the least, a discussion about entities is needed when individual differences are studied in teams. The pairs of concepts that will be discussed are *groups and clusters*, and *levels and units*.

Groups and clusters

With groups and clusters, we organize the entity dimension of data. In team research, the terms *groups* and *clusters* are used interchangingly. Clusters can also be referred to as nesting variables (Nezlek, 2011). Since the terms are used to refer to the same thing, there is no clear distinction between them. Yet, to think about what different groups and clusters we use can help us to manage the entity dimension of data.

An example of how to use subgroups to organize the entity dimension of data was proposed in Study 2, with groups of Chief Executive Officers (CEOs) and Chief. The division of the study sample into groups of CEOs and CFOs was a test of group differences that could be chosen on the basis of research aims. Teams, on the other hand, are not modeled only based on a research interest in a particular categorization. In data analysis, teams are based on the concrete constellations of persons that make data within teams dependent (Snijders & Bosker, 2011). Perhaps we find the most straightforward example of the relationship between persons in

teams and variables in the phrase "group dynamics". Group dynamics must take place in groups in which members interact with each other (Arrow et al., 2000). A team is a constellation of members who meet or work together, which makes them *interdependent* (Courtright et al., 2015; Marks et al., 2001). What is tested in statistical analysis when we study teams is not the existence of groups, as it can be in cluster analysis (Howard & Hoffman, 2018). With teams, we will already know that there are different group-, or cluster constellations.

When groups refer to different populations of individuals and to teams respectively, data can be organized the same way, with variables in columns and entities in rows. But the relationship between entities and variables are slightly different. With groups of e.g., CEOs and CFOs, the division into groups is *based on a groping variable*; different job descriptions, that researchers could choose to study or not. With groups like teams, the division into groups is about the *dependence between persons in relationship to a variable*, e.g., a team process. It is not the organization of data that differs between the two types of groups, but the relationships between entities and variables yield different meanings of groups. In Study 2, it was suggested that data be restructured to access the individual level of analysis instead of team units. The restructuring of data was an example of how the relationship between entities and variables can be managed in the organization of data. The restructuring of data allows researchers to choose what meaning of groups is desirable; population samples of individuals- or team constellations.

Differences between groups and clusters are not always clear and the words are used interchangingly, but different types of groups and clusters could be utilized when we study individual differences in teams. Woo et al. (2018) presented a thorough review of person-centered approaches in organizational research, arguing that there is a need to understand analysis techniques such as cluster analysis to parallel the development of the multilevel modeling framework. The addition of person-centered approaches to research about individual differences in teams has potential to enrich our knowledge. Clustering techniques could let us study individual differences in team samples, across teams, preferably in combination with multilevel modeling, that already addresses the predefined clusters that teams are.

Throughout this dissertation, I refer to the person-centered approach to refer to methods to study individuals that are grouped into teams. The most conventional understanding of the person-centered approach would likely be clustering techniques of persons, based on some set of variables, to study subgroups (Howard & Hoffman, 2018). The person-centered approach can also mean that persons, rather than other units, are studied (Woo et al., 2018). In my suggestions about using team roles, both of these aspects are in play. I aimed to study persons, or individuals, as opposed to teams, and I suggested that this is possible by studying subgroups. Whilst the person-centered approach typically would study how similar individuals are on a set of variables, I studied how different individuals are in relation to their common

team cluster variables. Subgroups as such was a means to access persons (or individuals), in the predefined team clusters of data.

Roles- subgroups across team clusters

Roles can be thought of in terms of subgroups, and contrasted with teams, i.e., the small groups or clusters that they relate to. Most typologies of roles tend to separate task- and social roles. Roles themselves are defined as behaviors that are expected of the persons in particular roles (LePine et al., 2011).

Roles in study 2 and 3 are not about social- and task roles but about formal-, or new venture roles (Jung et al., 2017). They are not about role fulfilment, but they serve as a categorization of team members into subgroups. This categorization separates out one individual per team into the resulting subgroups. No aggregations of roles back into teams were performed. Stewart et al. (2005) on the other had studied roles aggregated to the team level, i.e., as team composition. No aggregation of team member roles was performed in the dissertation, because the purpose of the categorization of individuals according to their roles was not to study team composition. Instead, the purpose was to test relationships between personality and team level outcomes, with the individual as the unit of analysis in subgroups. That is, the role groups were created for the methodological reason to keep the individual level unit of analysis. Role groups helped to avoid the modeling of personality at team level, and yet make possible to relate personality to team level outcomes. Expressed differently, the team level of analysis was incorporated at the individual level of analysis by team roles. The hierarchical constellations of individuals, when both team role subgroups and team clusters are considered, is depicted in Figure 6.
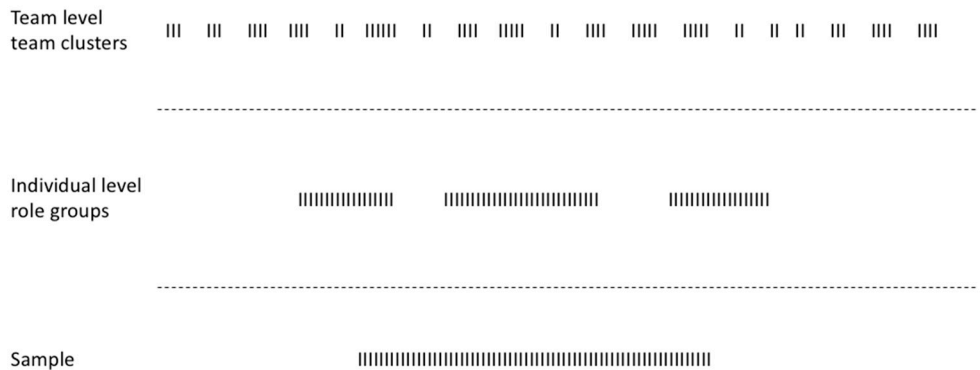

Figure 6. The hierarchical structure of individuals in the role subgroup approach

When subgroups are modeled at the individual level, individuals that come from same teams are separated. For an example, the group of chief executive officers (CEOs) in study 3, was one person from each team, the ones who were CEOs,

grouped together at the individual level. With one person from each team, the role categories are groups across teams, or across the team clusters. This design is related to the person-centered approach, as it forms subgroups of individuals to enable analysis of persons. The roles are as such a methodological suggestion to access individual level analysis, and are rather not about the theoretical or measurable properties of roles per se.

The difference between groups and clusters may not be clear cut, but is fundamental when we think of the entity dimension of data. Closely related is another pair of concepts; levels and units.

Levels and units

Throughout the dissertation work, I have come across many terms with the word *levels* in them. Concepts with levels often seem intuitively obvious in the context that they are written about. But, in the case of research on personality in teams, more than one theoretical or analytical framework may be necessary to relate to, and terminology with the word "levels" can be a source of misunderstandings. The misunderstandings can occur when units of interest or analysis is not monitored in relationship to variables, i.e., the different levels that we let variables vary across. Whilst the concepts groups and clusters, that were discussed above, are difficult to separate and are used interchangingly, levels and units are distinguishable.

Levels is often a descriptive term in hierarchies. Both in personality research and in team research, levels are a key concept in descriptions of hierarchies. The typical hierarchical case from each of the two research fields however is different from one another. In personality research, personality variables are often modeled in hierarchical structures, so that personality trait dimensions are overarching to more fine grained personality traits, called facets, which in turn are organized in groups of the observed variables that are items (the questions that the sample subjects have responded to) (e.g., Saucier & Ostendorf, 1999). The purpose of this hierarchical modeling of variables is to study the different latent components of personality traits, from the Five factor personality traits at the top of the hierarchy (Costa Jr & McCrae, 1995), potentially all the way down to item residuals. The levels, like "facet- level", or "item-level", refer to the different variable components in the models. The only unit of analysis in these hierarchical models of personality, is individuals. It could be said that different aspects of personality are compared across individuals.

Team research, on the other hand, is almost by definition hierarchical- since it is about individuals who work together and depend on each other to achieve their goals. A clear example of the hierarchy that must be managed in team research is the frequently utilized multilevel modeling techniques, along with multilevel theory

in team research (Kozlowski & Klein, 2000). Researchers can let variables vary at different levels, when appropriate. Most often, a team researcher will want to study the team level, but variables can also be modeled and controlled for at the individual level (Snijders & Bosker, 2011). The levels referred to in this type of models are about the different entities or units of analysis, individuals and teams, that variables are set to vary across. That makes two units of analysis and two levels. Apart from these levels, that correspond to different units of analysis, modern team research also can employ latent variable models. Just like in the example of hierarchical models in personality research, latent variable models will result in additional levels of variables that are not about units of analysis. Herein lies an important difference about variables and persons, or team members.

Should we draw pictures of one hierarchical model of a personality trait and one model of individuals in teams, they could look the same. An example of this is presented in Figure 7.
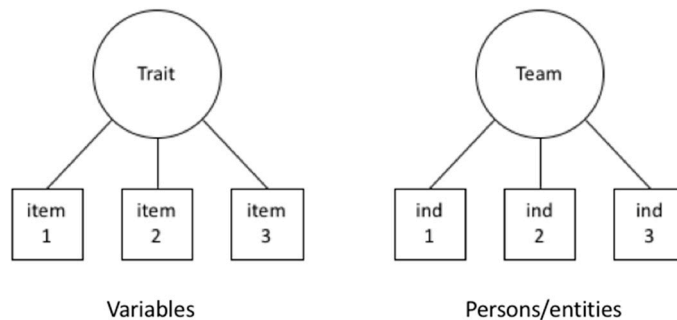

Figure 7. Variables and entities as hierarchical structures.

The two depicted hierarchies look the same but are *very* different things. They are furthermore a very straightforward example of the difference between considering data in terms of the variable dimension and considering data in terms of the entity dimension. A hierarchical model of personality traits will be about variables; their different latent and observed components, their relationships and relative contributions. A hierarchical-, or multilevel, model of teams and their members will be about concrete constellations of persons and their structure of relationships, that is necessary to account for when effects of variables are studied in teams. In the hierarchical model of personality traits, the unit of analysis is the individual at all levels of the model. In the multilevel model of individuals in teams, there are two levels, and two possible units of analysis; individuals and teams. My point is that levels may refer either to variable treatment in analysis, or to concrete constellations of the subjects that are studied. Sometimes levels in terms of both variable treatment and of subject constellations are the case in one and the same model. An example of this is found in Study 1 in this dissertation, and depicted in Figure 8.
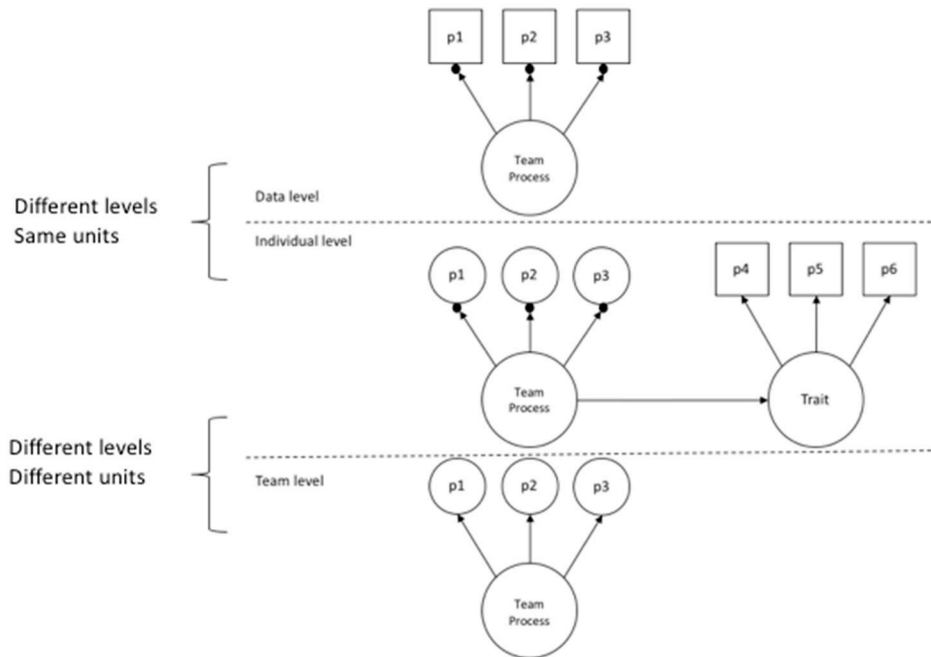
Figure 8. Levels and units in MSEM models from Study 1.

In Study 1, relationships between personality traits and team processes were studied at individual level, to investigate whether personality traits and team processes in part are overlapping constructs. In the analysis part of the study that used multilevel structural equation models, the data was organized both in terms of levels of variables (e.g., observed and latent), and in terms of levels of entities (individuals and teams). Perhaps most accessible of an example is the treatment of the longitudinal data as the "level one". It means that data was organized in three levels; the data level, the individual level, and the team level. The data level was only in the models because the data was longitudinal. That is, the first level of the models organized the data so that the repeated ratings were grouped together to one mean value per individual at the next level. As such, data- and individual were two levels, with the same unit of analysis, i.e., individuals. The difference between these levels was that they contained within- and between variability respectively. From the second level (the individual level) to the third level (the team level), data was again transformed so that statistical summaries represented the members of each team together at the third level. The individual level compared to the team level, was however not only different levels, but different units of analysis. That is, team units didn't just organize the data in the analysis, but they reflected actual relationships between the persons in the sample. Whilst the longitudinal data structure could have been organized differently- e.g., in panels or growth curves, the structure that marks

the individual versus the team level could not have been organized differently. The team clustering is about what individuals worked together and is thus independent from our research purposes. The team clustering can't be differently organized, like the longitudinal data can. (This is also be the case when a researcher has assigned participants into teams; the constellation of persons in teams is already defined when data analysis begins.) In summary, the entity dimension of data (Cattell, 1952), did not change between level one and two in the Study 1 models, but it did change between level two and three. Study 1 thus poses an example of the differentiation between levels and units that I have discussed above.

A psychometric approach to individual differences in team research

It is perhaps an obvious feature in personality theory that individuals are the unit of analysis (e.g., Paunonen & Hong, 2015). But also in the modeling of teams, the individual unit of analysis is an inherent building block. In organizational psychology and team research, the models by which constructs are aggregated to a higher level are called compilation- and composition models (Bliese, 2000; Mathieu et al., 2014). Lüdtke et al. (2008) make a straightforward translation of these concepts into the psychometric terminology. Compilation models, sometimes also called configural aggregations, Lüdtke et al. (2008) refer to as formative models. This model has the lower level for a focus, which is the individual level in team research. With formative, or compilation models, it is acknowledged that individual team members have different true scores and that the scores from the different team members therefore not are interchangeable. It is the variability of individual true scores that forms the configural construct at team level. As such, each individual team member serves as an indicator of the higher level, team, construct. With composition models, that Lüdtke et al. (2008) equal to reflective models, the score from each individual team member reflects the team level construct. The scores from different team members are caused by the team construct and are interchangeable, which means that it does not matter from which specific individual a score comes from, since true scores are only at team level. It is noticeable that also in the description of reflective group level constructs, Lüdtke et al. (2008) refer to individuals as indicators. Both Bliese (2000) and Lüdtke et al. (2008) point out that aggregated constructs rarely are purely formative or reflective, but both aggregation mechanisms are involved at the higher level. The modeling of teams as such is not entirely variable centered (Howard & Hoffman, 2018), but also about the individuals who make up team constellations. In this dissertation, I have suggested that one way of understanding teams is therefore to study individual differences, also when we study team level constructs.

Limitations and future research

The studies in the dissertation do have some shortcomings that must be addressed. One such is that the roles that were selected to create groups across teams in both study 2 and 3, are in a way arbitrary. They are not arbitrary in that they relate to persons to their teams, but other roles would be imaginable. For an example, roles that have been related to team processes in previous research, social- and task oriented roles (Stewart et al., 2005) would be important to study in designs that do not change the unit of analysis. It is also thinkable that other roles than formal roles in the samples of new venture teams would be available, if it was carefully investigated. E.g., there could be informal roles or roles influenced by e.g., how much ownership different team members hold. Future studies would benefit from investigating what roles would be available in new venture teams, or teams by and large, when the subgroup categorization method is applied.

On that note, only new venture teams were studied in the dissertation. The idea to study individual differences in teams whilst maintaining the individual unit of analysis is not anyhow uniquely attached to the new venture team context, but would apply to teams in general. It however may be that new venture teams differ from other kinds of teams in some aspects. Should they for an example have members that are systematically less dependent on each other than team members in other types of teams are, then the individual unit of interest and analysis may be somewhat less important in other types of teams. There is no obvious reason to think that new venture teams are very different from other teams, but in future research, it should be investigated if they are, for valid generalizations about teams, by and large, to be possible.

Sample sizes in all three studies were small. Also as examples of methodological variants to study individual differences in teams, larger samples would have resulted in more robust applications of the examples. That is, larger sample sizes could have made possible more advanced analysis. For an example, the small sample sizes limited the analysis in Study 1, so that random slopes, from the relationship between personality and team processes at individual level, could not be modeled at team level. One way that future research could approach access to data is to reuse data that has already been collected to study teams. That is, since much research on personality in teams has focused on the team level as the unit of interest, much data could be reanalyzed with the individual as the unit of analysis.

It is important to say that the suggestions made in the dissertation on how to make use of individual level variability when teams are studied is not intended as a means of finding more significant relationships in data. Only in Study 3, relationships at both team- and individual level were reported. When same variables at both levels are analyzed and reported, theory and hypothesis still must help to guide interpretation, not at least since relationships at different levels might not carry the same conceptual meaning (Stapleton & Johnson, 2019).

Some technical, psychometrical, issues will appear if researchers study individuals in teams such as I have suggested, with more of a person-centered approach. In a comment on the work of Nesselroade and Molenaar (2016), Revelle and Wilt (2016) object that a certain design accounting for variables, occasions and individuals would result in invariance of latent variables within subjects. This type of problems would be to expect if the research traditions from team- and personality research can be integrated in the future, which would involve not only the variable- and entity dimension of data but also the measurement occasion one. And so apart from empirical studies needed in the future to understand and validate the individual level variability, psychometric properties must be investigated when the data box is rotated in different new designs and analysis techniques. One way to get ahead with psychometric developments is to use methods that are already available, but typically applied with regards to some other aspect of data than the person/entity dimension. An example of this is the intraclass correlation (Shrout & Fleiss, 1979). Intraclass correlations have often been applied to study the amount of variance that can be ascribed to the team level, and counts as a reliability measure that can justify the modeling of team level variability at all (Kozlowski & Klein, 2000). This could be applied to the person/entity unit of team data, so that the addition of variable scores from team members with different features can increase or decrease the intraclass correlation. E.g., team members that have formal roles may display some agreement on a team process variable, seen in the intraclass correlation. The addition of variable scores from team members that have informal or more distal roles may decrease (or increase) the intraclass correlation.

Another example of psychometric studies that are not only potential developments but necessary, are invariance studies (Meredith, 1993). As mentioned above, the conceptual meaning of variables may change over levels (Stapleton & Johnson, 2019). It can however be tested if personality tests, or measures of other individual differences, are psychometrically appropriate for use at team level. That is, if the quality of measurement changes from level to level (Little, 2013; Silva et al., 2019). If it changes too much, it is problematic to model variables at different levels (Van De Schoot et al., 2015). Invariance studies could be performed in simulations, since the psychometric properties of many personality tests already are known and available.

Some advanced statistical methods have the potential to manage the individual level unit of analysis next to the team unit. An example of this may be the suggestion by Hamaker et al. (2015), who proposed that individual level trait-stability must be modeled explicitly in panel models, or estimates between measurement occasions may be erroneous. Another statistical analysis that potentially can model individuals with the unit of analysis intact in teams, is one suggested by Lang et al. (2019). They proposed a multilevel group process framework, with growth curves at the lower level of analysis. The framework is explicitly developed to study change over time and as such addresses the measurement occasion dimension in data. With advanced

modeling techniques, decisions about how to model individual differences to make inference about them still linger. Advanced models do not per se guarantee that the individual unit of analysis can be maintained. For an example, DeRue et al. (2010), aimed to "move beyond agreement and aggregation", and suggested analysis that treats team variability in terms of dispersion or distributions, which considers team units. To find out what advanced analysis techniques can house individual units in team research, and how well, is a task for future research.

Summary and conclusions

When individual differences are studied in teams, the unit of analysis has most commonly been the team (e.g., Barrick et al., 1998; Bell, 2007; Emich et al., 2021; LePine et al., 2011). Individual differences and team constellations however stem from different research traditions. Although both of these traditions tend to focus on the study of variables, they apply to different entities or units of analysis. The different units of analysis and their relationships to variables have been illustrated in the dissertation using Cattell's data box (Cattell, 1952). Two methodological suggestions to study individual differences in team constellations were made. The suggestions aimed to use or maintain the individual unit of analysis when studying individual differences in relation to team level variables. The first suggestion was to study construct overlaps between personality traits and team processes at individual level, i.e., to what extent personality and team process measurement assess the same constructs. The second suggestion was to study subgroups of individuals across teams, with the use team roles as categorizing variables, which allows for analysis with the individual as the focal unit of analysis yet is related to team constellations.

The studies in the dissertation are first and foremost examples of the methodological suggestions made, that can let researchers take stances on what unit of measurement and analysis they should use when they study personality in teams. Results implied a meaningfully large content overlap between personality traits and team processes at the individual level, and that team roles may reveal individual differences of both personality and team processes, directly relating to a team level outcome. Throughout the studies, analysis across individuals in teams was performed, as opposed to analysis within or between teams.

The terminology that surrounds the units of analysis in team research was discussed with examples from the studies. The discussion highlighted how the persons/entity dimension of data could be approached to study individual differences in team constellations. Future research has for a task both to study personality in teams with the individual as the focal unit of interest, and to develop the methodological means and agenda to do so.

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