Personality and Team Performance: A Meta-Analysis[†]

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Abstract

Using a meta-analytical procedure, the relationship between team composition in terms of the Big-Five personality traits (trait elevation and variability) and team performance were researched. The number of teams upon which analyses were performed ranged from 106 to 527. For the total sample, significant effects were found for elevation in agreeableness ($\rho = 0.24$) and conscientiousness ($\rho = 0.20$), and for variability in agreeableness ($\rho = -0.12$) and conscientiousness ($\rho = -0.24$). Moderation by type of team was tested for professional teams versus student teams. Moderation results for agreeableness and conscientiousness were in line with the total sample results. However, student and professional teams differed in effects for emotional stability and openness to experience. Based on these results, suggestions for future team composition research are presented. Copyright © 2006 John Wiley & Sons, Ltd.

INTRODUCTION

Teamwork appears to be the trend within many organizations (e.g. West, Borill, & Unsworth, 1998; West, 1996). The rationale behind structuring work into teams is that the combination of complementary employee skills, knowledge, attitudes, and other characteristics will result in optimal achievement of organizational goals. Scholars set out to find out whether this rationale actually holds true, focusing on teamwork and its effects. One of the research topics they addressed was, and still is, that of the relationship between team composition in terms of personality and team effectivity.

This line of research–along with other personality research–substantially gained from the consensual attainment of the conceptual and measurement framework for the

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personality construct: the 'Five-Factor Model' of personality, or the so-called 'Big-Five' (Digman, 1989, 1990; McCrae & Costa, 1989; McCrae & John, 1992). Since the origination of this framework, (e.g. Goldberg, 1983, 1990), the number of studies dedicated to the relationship between team composition in terms of Big-Five personality traits and team effectiveness has slowly mounted. Although each of the previously conducted studies provided a unique contribution to the scientific literature, future research in this respect would greatly benefit from a meta-analysis that systematically assesses and integrates results obtained so far. Not only would such a meta-analysis enlarge our understanding of how team composition in terms of team member personality influences team effectivity, it would also provide insight into what research questions will have to be addressed in the future (cf. De Fruyt & Salgado, 2003). Therefore, the aim of this study is (a) to provide a meta-analytical answer to the question: How is team composition in terms of personality related to team performance?, and (b) to signal directions for future research.

The structure of this paper is as follows. First, the criterion measure team performance is discussed. Subsequently, the predictor measures are discussed: (a) the Big-Five personality traits are defined, (b) the operationalization of team composition in terms of the Big-Five personality traits is discussed and (c) for each operationalization of each of the five traits, expectations and results regarding their effect on team performance are discussed, always ending with the presentation of trait-specific expectations for the meta-analysis. Next, the expected moderation is discussed. In the method section, the literature search method, the criteria for inclusion of the studies and the method via which we conducted the meta-analysis are explicated. Subsequently, results are presented, culminating in a discussion of what these results tell us about what future research is needed with respect to the relationship between team composition in terms of personality and team performance.

CRITERION MEASURE: TEAM PERFORMANCE

Team performance is generally represented by a subjective rating of a team by their instructors (student teams) or supervisors (professional teams). These ratings are made at the team level for a number of task relevant dimensions (including quality, quantity, planning and timeliness of the work and aspects of communication within the team) and are then combined in a composite score. The relationship between the team and the rater can be different. Some teams work closely together with the supervisor (English, Griffith, & Steelman, 2004; Van Vianen & De Dreu, 2001), whereas other supervisors are more independent of the team (Kichuk, 1999). In an effort to diminish subjectivity, some researchers included supervisory ratings on objective aspects of the team product in their measure of team performance (Kichuk, 1999; Neuman, Wagner, & Christiansen, 1999), or they had multiple raters with different backgrounds determine the team's performance (Kichuk, 1999; Mohammed & Angell, 2003; Neuman et al., 1999; Neuman & Wright, 1999). Only in experimental studies were objective measures used to describe the team's performance (Graziano, Hair, & Finch, 1997; LePine, 2003).

Common to the majority of team performance ratings is that they are task specific and that they have been made by a supervisor or instructor at the team level. All studies with such a team performance rating will be included in our meta-analysis.

PREDICTOR MEASURES

Definition of the Big-Five personality traits

The Big-Five framework of personality distinguishes five factors: *extraversion, agreeableness, conscientiousness, emotional stability* and *openness to experience* (De Raad, 2000; McCrae & John, 1992; Wiggins, 1996). The premise of the framework is that the factors remain stable and consistent over time and situations, and that each factor predisposes a person to behave in a certain way (Robertson & Callinan, 1998). Each of these traits can be described by a number of behavioural terms. Here, only exemplary behavioural terms will be presented (for complete descriptions, see e.g. Costa & McCrae, 1992; Hendriks, Hofstee, & De Raad, 1999). Extraversion refers to the extent to which a person is social and talkative. Agreeableness refers to the extent to which a person is gentle and cooperative. Conscientiousness refers to the extent to which a person is self-disciplined and organized. Emotional stability refers to the extent to which a person is calm and poised and finally, openness to experience refers to the extent to which a person is imaginative and curious. Every person's personality can be described in terms of these five traits and, as presumed, a person's personality remains relatively stable over time and across situations (Hofstee, Kiers, De Raad;, Goldberg, & OstendorfJ, 1997; John & Srivastava, 1999; McCrae & Costa, 1997). Furthermore, factor- and content analyses of differential measurements of the Big-Five consistently replicate the underlying five-factor structure (John, 1990; Mount & Barrick, 1995).

Within each of the five traits, a number of facets are distinguished. Saucier and Ostendorf (1999) delineated 18 of them in large English and German samples. Nevertheless, both the number and method of measurement of facets vary per instrument. To name two well-known instruments: the NEO-PI-R distinguishes six facets per trait (Costa & McCrae, 1992), each of which is measured by eight questions, whereas the Five-Factor Personality Inventory (Hendriks et al., 1999) distinguishes 81 blends of positive and negative poles of the primary factors in so-called circumplex models. Since there is a large number of facets and because of the differential measurement and definition of the facets, research into team composition in terms of personality is usually limited to the Big-Five traits.

The implication of the foregoing for our meta-analysis is that we will only include studies that used the Big-Five framework to measure personality. Furthermore, we will restrict ourselves to the effects of traits, since results of the facets within each trait are hardly available and difficult to compare.

The operationalization of team composition in terms of personality

To be able to study the effects of personality within a team, researchers have to convert individual personality trait scores into a measure that represents team composition in terms of personality. Almost all researchers distinguish between two characteristics of the team composition in terms of personality: the *elevation* and the *variability* of a certain trait within a team (Barrick, Stewart, Neubert, & Mount, 1998; Kichuk & Wiesner, 1998; Mohammed & Angell, 2003; Neuman et al., 1999; Van Vianen & De Dreu, 2001). Trait elevation is calculated by the averaged or summed individual scores for a trait, or by the proportion of high scoring individuals on a trait. Trait variability is represented by a team's variance or standard deviation score for a certain trait. Trait elevation and trait variability

are generally negatively correlated[1], but in the majority of studies, these correlations are only significant for agreeableness and conscientiousness. Barrick et al. (1998) cited that historically also the minimum and maximum scoring team members per trait were taken into consideration when studying the effects of team composition in terms of personality, but only few researchers used these operationalizations (Barrick et al., 1998; LePine, 2003; Van Vianen & De Dreu, 2001).

Given the fact that the predominant operationalizations of team composition in terms of personality used up till now are trait elevation and trait variability, we will perform our meta-analysis upon both of them.

Hypotheses

We built our hypotheses for trait elevation and variability on both expectations described in research so far, and on the extent to which there is empirical support for these expectations. It is remarkable that a lot of hypothesizing has been done so far, but only few results are available to empirically underscore these expectations. Per trait we discuss (a) expectations about elevation, (b) results about elevation, (c) expectations about variability, (d) results about variability and we conclude each section with (e) the presentation of our hypotheses for the meta-analysis.

Extraversion

With regard to the elevation of extraversion, researchers acknowledge extraversion to be important for a smooth functioning of the social mechanisms within a team, since it is by description strongly linked to intra-team processes or contextual performance (i.e. performance regarding the social and motivational context in which a team operates (Borman & Motowidlo, 1993)).With regard to effects of elevation of extraversion, researchers propose different hypotheses. On the one hand, extraverts are talkative, outgoing, enthusiastic, energetic, optimistic and assertive (Costa & McCrae, 1992) and researchers expect these characteristics to result in a positive attitude towards teamwork (Barrick et al., 1998; Barry & Stewart, 1997) and high performance expectations (Barry & Stewart, 1997). Furthermore, extraverts in a team are expected to stimulate discussion (Mohammed & Angell, 2003; Taggar, 2002) and their attitude should foster a climate in which team members feel free to express themselves (Barry & Stewart, 1997). This freedom of expression is critical for the quality of the decisions the team will have to make with regard to the task (Schultz, Ketrow, & Urban, 1995). On the other hand, researchers also express caution over the inclusion of too many extraverts in a team, since this may harm the team's effectiveness. Extraverts may be expected to like to work within a team merely for the possibility of social interaction this offers them (Neuman et al., 1999). This focus on pleasurable social interaction is expected to distract their attention from task completion (Barry & Stewart, 1997; Mohammed & Angell, 2003). Furthermore, because of their talkativeness and assertiveness, extraverts tend to be dominant (Kichuk & Wiesner, 1998). Researchers expect that a team that is composed of too many dominant individuals will likely engage in conflict over team issues (Mazur, 1973), like, for instance, leadership (Barry & Stewart, 1997; Mohammed & Angell, 2003). So the expectations concerning elevation of extraversion are mixed, which leads researchers to expect a curvilinear effect of extraversion elevation on team effectiveness. Results of Barry

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[1]The correlation between trait elevation and trait variability was found for extraversion, agreeableness, conscientiousness and emotional stability in five studies and for openness to experience in three. The weighted average correlations are extraversion -0.08, agreeableness -0.36, conscientiousness -0.22, emotional stability 0.01 and openness to experience -0.26.

and Stewart (1997) indeed showed that intermediate levels of the elevation of extraversion within a team lead to high team performance.

The emphasis of researchers on either positive or negative effects of the elevation of extraversion at the same time forms the basis for the expectation of a positive effect of variability in extraversion. This expectation is supported by findings by Neuman et al. (1999).

Since we cannot research curvilinear effects meta-analytically and since curvilinear elevation effects counterbalance each other, we only expect variability in extraversion to be related to team performance. Therefore we propose the following hypotheses:

H1a Elevation of extraversion is not related to team performance.
H1b Variability in extraversion is positively related to team performance.

Agreeableness

Elevation in agreeableness is, without exception, expected to be positively related to team effectiveness. As with extraversion, the effect of agreeableness is expected to manifest itself through its favourable effect on team processes or contextual performance. Team members high in agreeableness are friendly, tolerant, helpful, altruistic, modest, trusted, straightforward (Costa & McCrae, 1992) and non-competitive (Graziano, Hair, & Finch, 1997). Researchers expect these characteristics to facilitate interpersonal attraction (Neuman & Wright, 1999) and thus cooperation (Barrick et al., 1998; Mohammed, Mathieu, & Bartlett, 2002; Neuman & Wright, 1999; Taggar, 2002), smooth conflict resolution (Barrick et al., 1998; Neuman & Wright, 1999; Taggar, 2002), open communication (Neuman & Wright, 1999), information-seeking (Taggar, 2002), compliance with team goals, and task cohesion (Van Vianen & De Dreu, 2001), group cohesion (Barrick et al., 1998; Greene, 1989) and alignment (shared mental model) on the most effective way to work together as a team (Klimoski & Mohammed, 1994). Results of empirical studies confirm the expectation that higher levels of agreeableness lead to higher team performance (Barrick et al., 1998; Graziano et al., 1997; Neuman et al., 1999; Neuman & Wright, 1999; Van Vianen & De Dreu, 2001).

Variability in agreeableness (Mohammed & Angell, 2003), or even the presence of one single disagreeable team member is expected to disrupt cooperation (Barrick et al., 1998), which is costly in terms of social rewards (Thibaut & Kelly, 1959). So a negative relationship between variability in agreeableness and team performance is predicted. The few empirical results available so far support this hypothesis: performance (oral presentation) is better when teams have a lower variability in agreeableness (Mohammed & Angell, 2003). Considering these predictions and results, we expect for our meta-analysis that:

H2a Elevation of agreeableness is positively related to team performance.
H2b Variability in agreeableness is negatively related to team performance.

Conscientiousness

Since conscientiousness is the most consistent predictor of individual performance (Hurtz & Donovan, 2000; Salgado, 2003), researchers expect this propitious effect of the elevation of conscientiousness to present itself at the team level as well. Highly conscientious team members are thorough, hardworking, responsible, self-disciplined, organized, self-motivated and achievement- and task-oriented (Barrick & Mount, 1993; Costa & McCrae, 1992; Goldberg, 1993). Researchers expect these characteristics to result in effort and perseverance toward team goal completion (LePine, 2003; Molleman, Nauta, & Jehn, 2004; Mohammed & Angell, 2003; Neuman & Wright, 1999; Taggar, 2002; Van Vianen &

De Dreu, 2001), a focus on and commitment to the task (Barry & Stewart, 1997; Taggar, 2002), cooperation (Molleman et al., 2004) and role adaptation in face of changes within the team or task (LePine, 2003). The lack of these characteristics, may lead to social loafing or free riding (Mohammed & Angell, 2003; Molleman et al., 2004; Neuman et al., 1999). Considering this, researchers expect a positive effect of the elevation of conscientiousness within a team. Results of several empirical studies support these expectations, as they show that higher elevation of conscientiousness within a team leads to higher team performance (Barrick et al., 1998; Neuman et al., 1999; Neuman & Wright, 1999; Van Vianen & De Dreu, 2001 (student sample and combined sample)) and more specifically to better team performance in writing reports (Mohammed & Angell, 2003) and making decisions (Neuman & Wright, 1999).

With respect to variability in conscientiousness, researchers hypothesize that similarity in conscientiousness will lead to cohesion (Van Vianen & De Dreu, 2001), whereas dissimilarity in conscientiousness may lead to conflict and diminish a team's effectiveness (Mohammed & Angell, 2003; Molleman et al., 2004). Thus, a negative effect of variability in team member conscientiousness on team performance is predicted. In the empirical studies that have been carried out, it has indeed been demonstrated that higher team performance is reached when teams have a lower variability in conscientiousness among team members (Barrick et al., 1998; Kichuk, 1999). Based on these expectations and results, in our meta-analysis we expect to find that:

> H3a Elevation of conscientiousness is positively related to team performance.
> H3b Variability in conscientiousness is negatively related to team performance.

Emotional stability

Team members whose elevation in emotional stability is high are described as self-confident and secure about chosen goals and decisions (Molleman et al., 2004; Van Vianen & De Dreu, 2001). Researchers expect these qualities to foster cooperation, a relaxed team atmosphere (Barrick et al., 1998; Molleman et al., 2004), stability within the team and coordination of work behaviours (Neuman et al., 1999) and task cohesion (Van Vianen & De Dreu, 2001). Based on this and on previous findings of Haythorn (1953), Helslin (1964) and Thoms, Moore, and Scott (1996), the elevation of emotional stability is expected to be positively related to team performance. Results of separate studies support this expectation (Barrick et al., 1998; Kichuk & Wiesner, 1998; Molleman et al., 2004).

Considering variability in emotional stability, researchers hypothesize that the presence of one single (Barrick et al., 1998; Neuman et al., 1999; Van Vianen & De Dreu, 2001) or just a few (Mohammed & Angell, 2003) unstable or neurotic team members will have an adverse effect on team effectiveness by disrupting the cooperation, the atmosphere or the cohesion within a team. So, variability in emotional stability is expected to be negatively related to team performance. However, in studies conducted to test this hypothesis, results for variability were mixed (negative effect: Mohammed & Angell, 2003; positive effect: Neuman et al., 1999). Given the results obtained so far, for our meta-analysis we hypothesize that:

> H4a Elevation of emotional stability is positively related to team performance.
> H4b Variability in emotional stability is not related to team performance.

Openness to experience

Relatively few researchers include openness to experience in their research or hypothesize about effects of this trait. With regard to the elevation in openness to experience, researchers reckon team members high in openness to be creative, broadminded, and willing to experiment or to try new things (LePine, 2003; Molleman et al., 2004). Team members possessing these characteristics are expected to adapt easily to new situations, build upon each other's ideas, and look for alternative ways to solve problems they encounter (LePine, 2003). They are also expected to foster a creative atmosphere in which team members have opportunities to learn and to experience satisfaction (Molleman et al., 2004). Researchers expect positive relationships between elevation of openness to experience and team performance. Results with regard to openness obtained in individual studies using correlational analysis so far are mixed (positive, Neuman et al., 1999; negative,Van Vianen & De Dreu, 2001 (student team sample)). Results of studies using regressional analysis however show that higher elevation of a team's openness results in better decision-making performance (LePine, 2003) and higher overall team performance (Neuman et al., 1999).

With respect to variability in openness, researchers hypothesize that if all team members are highly open to experience, this may result in conflict and lowered cohesion, because all team members want to get their way (Van Vianen & De Dreu, 2001); in short, they expect beneficial effects of variability in openness. However, none of the studies conducted so far has shown either positive or negative effects of variability in openness to experience on team performance.

Although expectations and results are somewhat mixed, in general they favour a positive effect of elevation of openness. Furthermore, the expected positive effect of variability in openness is not supported by results. Therefore our meta-analysis hypotheses are as follows:

> H5a Elevation of openness to experience is positively related to team performance.
> H5b Variability in openness to experience is not related to team performance.

Moderation of the main effects

When studying the effects of personality trait elevation and variability on team performance, differences may be expected to occur in a comparison of student teams and professional teams. These differences may be due to a number of aspects.

First, professionals can generally be expected to have more experience with teamwork than students. Higher levels of teamwork experience can be expected to smoothen cooperation and thus lead to better (contextual) performance, especially when high levels of cooperation are required. Mohammed et al. (2002) included team experience in their study and found a negative effect of team experience on contextual performance and a considerable–though non-significant– positive effect on leadership performance. Since leadership effectiveness is positively related to all five personality traits (Judge, Bono, Ilies, & Gerhardt, 2002), professional teams that are more experienced in teamwork may exhibit positive relationships between personality and leadership performance, but negative ones between contextual personality traits and performance.

Second, professionals work together in teams for longer periods of time than students (professionals often work on a sequence of tasks within the same team (e.g. Barrick et al.,

1998; English et al., 2004; Van Vianen & De Dreu, 2001)). The longer a team has to work together, the more team members will have to make an effort to be able to keep on functioning as a team. Contextual performance may become more important and personality traits related to it may thus exert a stronger impact on the overall performance.

Third, professional teams perform different types of tasks than student teams do. A number of researchers pointed to the fact that the type or complexity of the task that is performed by a team has to be considered as a potential moderating influence on the results they had found (e.g. Barry & Stewart, 1997; Graziano et al., 1997; Mohammed & Angell, 2003). English et al. (2004) tested the moderating effect of type of task and found that the relationship between the (aggregated) elevation of conscientiousness and team performance was strongest for additive tasks (that is, when added inputs of the team members determine a team's performance (Steiner, 1972)).

Fourth, the extent to which professional and student team members are interdependent in order to successfully complete their task may differ. Interdependency will be strongly related to the distribution of task relevant knowledge within a team or to its multidisciplinarity. Most often, student teams are composed of members that study the same subject, and will thus be less interdependent than members of professional teams who often vary in skills and knowledge. The more interdependent team members are, the more attention they will have to pay to contextual performance in order to facilitate cooperation that is needed to integrate relevant knowledge as a result of which the task can be completed successfully. Therefore, personality traits related to contextual performance (agreeableness, extraversion, and emotional stability (Mohammed et al., 2002)) may have a stronger impact on overall performance in teams where the members are more highly interdependent.

Summarizing, differences between professional and student teams are to be expected based on their team work experience, the duration, type and complexity of their task and the interdependency among team members. Since these aspects are to a greater or lesser extent interrelated, it is difficult to formulate specific hypotheses for each of these aspects separately. That is why we explore the moderation for type of team (professional vs. student teams) without specific hypotheses.

METHOD

Meta-analysis procedure

The meta-analysis was conducted using the two-stage procedure of Hunter and Schmidt, 2004 (p. 180–182) for meta-analysis of correlations using artefact distributions. In the first stage, correlations were collected according to the following steps and criteria: The meta-analysis has been conducted upon research that has been published in refereed journals. To obtain a complete set of publications, two search methods were used. First, a computer-based literature search was conducted in PsychInfo (all databases) and in ABI/INFORM global (current files, back files and deep back files). The key words used were *Big-Five*, *personality*, *team performance*, and *team outcomes*. A second way in which articles were found was by executing a citations search in the reference sections of previously gathered articles. Studies that were included met the following criteria:

1. With regard to the variables under study (a) personality was described using the Big-Five framework, (b) trait elevation was operationalized via aggregated mean or summed scores, or via the proportion of high scoring team members, and variability was operationalized via variance or standard deviation scores and (c) a team's task performance was rated at the team level by supervisors who used task specific rating dimensions.
2. Effect sizes that expressed a direct relationship between Big-Five trait elevation within a team and team performance, or between Big-Five trait variability within a team and team performance could be found in the article.[2]
3. If independent subgroups were included in an article, they had to be analysed separately (e.g. professional and student teams). If several effect sizes applying to the same effect category were presented, then these were averaged before inclusion (e.g. written and oral performance).

To conclude the first stage, the correlations were corrected for artifact information that was available for all studies: sampling error. This was done for the total sample, and for both samples of the moderator analysis: the professional teams and the student teams. The results of this stage of the analysis are the estimates of the mean and standard deviation of the population correlation for each of the correlations in each of the samples.

In the second stage, the estimates of the first stage were corrected for artifact information that is only sporadically available. For our analysis this was information on reliability in the predictor measures, reliability in de criterion measure and direct range restriction in the predictor measures. We discuss each of them separately.

Information on the reliability of the elevation of personality traits was only given in a few studies. Sometimes, authors referred to reliabilities given in personality inventory manuals. We therefore created artefact distributions using information presented in meta-analyses on individual personality and individual performance (Hurtz & Donovan, 2000; Judge et al., 2002; Judge & Ilies, 2002; Salgado, 1997). The means and standard deviations of these distributions were: extraversion $m = 0.91$, SD $= 0.01$, agreeableness $m = 0.89$, SD $= 0.01$, conscientiousness $m = 0.91$, SD $= 0.01$, emotional stability $m = 0.91$, $SD = 0.02$, and openness to experience $m = 0.90$, $SD = 0.01$. These mean reliabilities were similar to those sporadically presented in the studies we included in our study.

Information on the reliability of the criterion measure was presented in three studies (Barrick et al., 1998; Neuman et al., 1999; Van Vianen & De Dreu, 2001). To derive an artifact distribution on the reliability of supervisory rated performance, we combined the reliabilities of team level supervisory ratings reported in the articles under study with those presented in meta-analyses on individual personality and supervisory rated performance (Hurtz & Donovan, 2000; Salgado, 1997, 2003) and that of Rothstein (1990) cited in Hunter & Schmidt (2004) and other individual level meta-analyses. The distribution had a mean of 0.83 and a standard deviation of 0.09.

Finally, distributions were created for the direct range restriction of each of the personality traits for the professional team sample. No information on range restriction was presented in the studies under analysis. Therefore we used information reported by Barrick & Mount (1991) and Hurtz and Donovan (2000). The mean and standard deviations of these distributions were.93 for all traits (agreeableness.94) and.01 (all traits), respectively.

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[2]One exception has been made with regard to this criterion. Effects were described in Kichuk and Wiesner (1998), but no effect sizes were reported in this article. Therefore these have been obtained via the dissertation of Kichuk (1999).

Using these distributions the estimated population correlations and standard deviations were corrected. The trait elevation–performance correlations were corrected for reliability in the predictor and the criterion measure. The trait elevation–performance correlations of the professional teams were corrected for range restriction in the predictor as well, since selection of employees is known to impose restriction upon the predictor scores. Range restriction was not expected to occur in the student team sub sample. To our knowledge, students are not selected for their study based on their personality scores. Furthermore, effects of self-selection due to study subject were not expected to occur, since the subjects of the students in the studies included in the meta-analysis were quite diverse. However, to facilitate comparison between the total and sub sample correlations, the overall trait elevation–performance correlations were corrected separately for reliability with and without direct range restriction. The trait variability–performance correlations were only corrected for reliability in the criterion measure.

RESULTS

Studies included in the meta-analysis

Depending on the trait under study, six to nine studies fulfilled the criteria specified above, yielding six to ten independent samples reporting effect sizes. All effect sizes used were expressed in terms of correlations. The studies included in the meta-analysis are presented in Table 1. For each study we described the team characteristics (type of team, number of teams studied, mean team size and tenure of members within the team), the task characteristics (description and duration of the task) and the way team performance was rated.

The sample sizes in the studies ranged from 24 to 88 teams, with an average of 52.7 teams. We did not control for the size of the teams, since the range of the mean team size was, on average, quite restricted, although the teams sampled by Barrick et al. (1998) formed an exception to this rule: when excluding teams of Barrick et al. (1998), mean team size ranged from 3–4.8 with an overall mean team size of 3.9; when including their teams, mean team size ranged from 3-13, with an overall mean team size of 4.8.

The professional and student team sub samples can be described as follows. Five of the ten samples consisted of student teams, the other five of professional teams. The professional teams had functioned together for a longer period of time–from 1 up to 3 year– and performed an ongoing task, but the tasks performed by the professional teams differed substantially (Barrick et al., 1998; English et al., 2004; Neuman et al., 1999; Neuman & Wright, 1999; Van Vianen & De Dreu, 2001). The student teams had to complete study projects or a task for research purposes. The duration of their projects was fairly short: 1 hour up to about 13 weeks, and their tasks were very similar in nature—creative or problem solving (Barry & Stewart, 1997; Kichuk & Wiesner, 1998; Mohammed & Angell, 2003; Mohammed et al., 2002; Van Vianen & De Dreu, 2001). Due to the confoundedness of these aspects, which may each cause the moderation of the relationship between personality and team performance, it is not possible to attribute differences found in the moderation analysis to either type of task, or tenure with the team, or the duration of the task.

In Table 2 the results of the meta-analysis are presented, starting with the number of studies (k), followed by the total sample size per category (N), the average weighted $\bar{r}$, the values of ρ (corrected $\bar{r}$), the standard deviation of ρ (SD_ρ), the 80% credibility interval

Table 1. Studies into the relationship between the Big-Five personality traits and team outcomes included in the meta-analysis

Authors[a]	Team characteristics	Task characteristics	Team performance
Barrick, Stewart Neubert, and Mount (1998)	• Type: professional teams • $n = 51$ • Mean size = 13 • Tenure with the team: on average 3.59 years	• Description: manufacturing • Duration: ongoing	The supervisory ratings on eight dimensions of team effectiveness were summed
Barry and Stewart (1997)	• Type: student teams • $n = 61$ • Mean size = 4.7 • Tenure with the team: two semesters	• Description: analytical, creative and problem-solving • Duration: one week for each of the three tasks	The instructor ratings of the quality of the performance on the three tasks were averaged. Instructors were unaware of the identities and predictor scores of team members
English, Griffith, and Steelman (2004)	• Type: Professional teams • $n = 30$ • Mean size = 3 • Tenure with the team: ?	• Description: flying a plane • Duration: ?	Crews' captains/supervisors rated the crew's performance based on a specifically developed crew performance appraisal
Kichuk (1999); Kichuk and Wiesner (1998)[b]	• Type: student teams • $n = 81–95$[c] • mean size = 3 • Tenure with the team: for the duration of the task	• Description: designing and building a newspaper bridge • Duration: 45 minutes	An independent rater 'supervised' by a recorder scored each bridge on length, width, height and strength using a predefined scoring key
Mohammed and Angell (2003)	• Type: student teams • $n = 59$ • mean size = 4.5 • Tenure with the team: 15 weeks	• Description: process—improvement project • Duration: 12–13 weeks	Course instructors (unaware of the students' predictor scores) graded written reports based on various criteria using feedback of the project sponsors. An audience of course instructors, project sponsors, classmates and special guests rated the project presentation

Continues

Table 1. (Continued)

Authors[a]	Team characteristics	Task characteristics	Team performance
Mohammed, Mathieu, and Bartlett (2002)	• Type: student teams • $n = 25$ • Mean size = 4.8 • tenure with the team: 15 weeks	• Description: real-life laboratory exercise: • Duration: 15 weeks cafetaria management	An instructor (unaware of the teams' predictor scores) rated a team's performance on two meal days on a number of dimensions which are combined in a composite score
Neuman, Wagner, and Christiansen (1999)	• Type: professional teams • $n = 82$ • Mean size = 4 • Tenure with the team: on average 3.5 years	• Description: customer service • Duration: ongoing	The human resources staff rated customer service ratings, and team supervisors rated task completion ratings. Both ratings were combined in a composite score
Neuman and Wright (1999)	• Type: professional teams • $n = 79$ • Mean size = 4 • Tenure with the team: 3 years	• Description: communication about and processing of employee claims • Duration: ongoing	Ratings made by three department supervisors (unaware of employees' predictor scores) on six performance dimensions were combined
Van Vianen and De Dreu (2001)	• Type: professional teams • $n = 24$ • Mean size = 3.6 • Tenure with the team: on average 13.4 months	• Description: drilling or placing underground cables and pipes • Duration: ongoing	Supervisory ratings (supervisors worked closely together with their teams) on eight dimensions of team effectiveness were summed
Van Vianen and De Dreu (2001)	• Type: student teams • $n = 28$ • Mean size = 3.8 • Tenure with the team: three months	• Description: research project • Duration: three months	Supervisory ratings (supervisors worked closely together with their teams) on eight dimensions of team effectiveness were summed

[a]Alphabetically ordered by first author.
[b]Details reported here were found in Kichuk (1999).
[c]rs are computed using the mean number of teams $n = 88$.

(CV) and the 90% confidence interval around the weighted average (CI). In this table values between brackets have been corrected for direct range restriction. In Table 3 the results of the moderation analysis for type of team are presented. Rhos are considered to be significant if the CI does not include zero.

Main effects

The finding that elevation of extraversion was not related to team performance ($\rho = 0.04$, $CI = -0.05$–0.13) is in line with H1a. However, although the effect of variability in extraversion was positive, as predicted in H1b, this effect was not significant ($\rho = 0.05$, $CI = -0.06$–0.18). Elevation of agreeableness ($\rho = 0.24$, $CI = 0.09$–0.39) was positively related to team performance, as predicted in H2a. Variability in agreeableness ($\rho = -0.12$, $CI = -0.16$–0.07) was negatively related to team performance, which is in line with H2b. Elevation of conscientiousness ($\rho = 0.20$, $CI = 0.09$–0.31) was positively related to team performance, as predicted in H3a. As stated in H3b, variability in conscientiousness ($\rho = -0.24$, $CI = -0.33$–0.14) was negatively related to team performance. We predicted a positive relationship between the elevation of emotional stability (H4a), but this effect was not found ($\rho = 0.04$, $CI = -0.06$–0.13); however, the prediction that variability in emotional stability is not related to team performance (H4b) is supported by the data ($\rho = 0.02$, $CI = -0.13$–0.16). Elevation of openness to experience was not positively related to team performance ($\rho = 0.03$, $CI = -0.14$–0.20) as stated in H5a, but findings that variability in openness to experience was not related to team performance ($\rho = -0.01$, $CI = -0.15$–0.12) are in line with H5b.

So, the higher the average level of agreeableness and conscientiousness within teams, and the more similar team members are with respect to agreeableness and conscientiousness, the better their team performs.

Moderation of the main effects

When testing for moderation of the effects of trait elevation, we found significant rhos for agreeableness of professional teams ($\rho = 0.51$, $CI = 0.42$–0.61), but not for agreeableness of student teams ($\rho = 0.02$, $CI = -0.11$–0.15). A significant rho was found for conscientiousness of professional teams ($\rho = 0.42$, $CI = 0.33$–0.51), but not for conscientiousness of student teams ($\rho = 0.00$, $CI = -0.07$–0.07). Furthermore, we found significant rhos for emotional stability of student teams ($\rho = -0.04$, $CI = -0.07$–0.01), but not for that of professional teams ($\rho = 0.14$, $CI = -0.05$–0.32). So, the higher the average level of agreeableness and conscientiousness within professional teams and the lower the level of emotional stability within student teams, the higher the team performance.

When testing for moderation of the effects of trait variability, we found significant rhos for agreeableness of both professional teams ($\rho = -0.13$, $CI = -0.16$–0.11) and student teams ($\rho = -0.08$, $CI = -0.15$–0.01). Significant rhos were also found for the variability in conscientiousness of professional teams ($\rho = -0.21$, $CI = -0.34$–0.08) and student teams ($\rho = -0.22$, $CI = -0.36$–0.08). However, we found significant rhos for variability in emotional stability of student teams ($\rho = -0.11$, $CI = -0.20$–0.02), but not for that of professional teams ($\rho = 0.16$, $CI = -0.01$–0.33), and significant rhos for openness to experience of professional teams ($\rho = -0.11$, $CI = -0.14$- -0.08), but not for that of student teams ($\rho = 0.08$, $CI = -0.11$–0.26). This means that findings of main effects of variability in the total sample are replicated in the sub samples for both agreeableness and

Table 2. Relationships between Big-Five trait elevation, Big-Five trait variability and team performance

Trait	k	N	$\bar{r}$	ρ	SD_ρ	80% CV lower	80% CV upper	90% CI lower	90% CI upper
Elevation[a]									
Extraversion	9	497	0.03	0.04 (0.04)	0.00 (0.00)	0.04 (0.04)	0.04 (0.04)	−0.05 (−0.05)	0.13 (0.14)
Agreeableness	9	497	0.17	0.24 (0.25)	0.20 (0.22)	−0.02 (−0.02)	0.50(0.53)	0.09 (0.09)	0.39 (0.41)
Conscientiousness	10	527	0.15	0.20 (0.21)	0.12 (0.13)	0.04 (0.04)	0.36 (0.38)	0.09 (0.09)	0.31 (0.34)
Emotional stability	9	497	0.03	0.04 (0.04)	0.00 (0.00)	0.04 (0.04)	0.04 (0.04)	−0.06 (−0.07)	0.13 (0.14)
Openness to experience	6	362	0.02	0.03 (0.03)	0.19 (0.21)	−0.21 (−0.23)	0.27 (0.30)	−0.14 (−0.16)	0.20 (0.22)
Variability[b]									
Extraversion	6	332	0.05	0.06	0.00	0.06	0.06	−0.06	0.18
Agreeableness	6	332	−0.09	−0.12	0.00	−0.12	−0.12	−0.16	−0.07
Conscientiousness	6	332	−0.17	−0.24	0.00	−0.24	−0.24	−0.33	−0.14
Emotional stability	6	332	0.01	0.02	0.08	−0.09	0.12	−0.13	0.16
Openness to experience	4	222	−0.01	−0.01	0.00	−0.01	−0.01	−0.15	0.12

[a] ρs are corrected for unreliability in predictor and criterion measures, ρs between brackets are corrected for unreliability in predictor and criterion measures and direct range restriction.
[b] ρs are corrected for unreliability in the criterion measure. CV = Credibility interval. CI = Confidence interval.

Table 3. Relationships between Big-Five trait elevation, Big-Five trait variability and team performance for professional teams and student teams

Trait	k	N	$\bar{r}$	ρ	SD_ρ	80% CV lower	80% CV upper	90% CI lower	90% CI upper
				Professional teams					
Elevation[a]									
Extraversion	4	236	0.11	0.15	0.34	−0.28	0.59	−0.17	0.47
Agreeableness	4	236	0.35	0.51	0.00	0.51	0.51	0.42	0.61
Conscientiousness	5	266	0.29	0.42	0.00	0.42	0.42	0.33	0.51
Emotional stability	4	236	0.09	0.14	0.12	−0.02	0.29	−0.05	0.32
Openness to experience	3	185	0.13	0.19	0.14	0.00	0.37	−0.03	0.41
Variability[b]									
Extraversion	3	157	0.13	0.16	0.00	0.16	0.16	−0.01	0.33
Agreeableness	3	157	−0.11	−0.13	0.00	−0.13	−0.13	−0.16	−0.11
Conscientiousness	3	157	−0.17	−0.21	0.00	−0.21	−0.21	−0.34	−0.08
Emotional stability	3	157	0.13	0.16	0.00	0.16	0.16	−0.01	0.33
Openness to experience	2	106	−0.09	−0.11	0.00	−0.11	−0.11	−0.14	−0.08
				Student teams					
Elevation[c]									
Extraversion	5	261	−0.04	−0.05	0.00	−0.05	−0.05	−0.16	0.06
Agreeableness	5	261	0.01	0.02	0.00	0.02	0.02	−0.11	0.15
Conscientiousness	5	261	0.00	0.00	0.00	0.00	0.00	−0.07	0.07
Emotional stability	5	261	−0.03	−0.04	0.00	−0.04	−0.04	−0.07	−0.01
Openness to experience	3	177	−0.09	−0.12	0.19	−0.37	0.13	−0.32	0.09
Variability[b]									
Extraversion	3	175	−0.03	−0.03	0.00	−0.03	−0.03	−0.10	0.04
Agreeableness	3	175	−0.06	−0.08	0.00	−0.08	−0.08	−0.15	−0.01
Conscientiousness	3	175	−0.18	−0.22	0.00	−0.22	−0.22	−0.36	−0.08
Emotional stability	3	175	−0.09	−0.11	0.00	−0.11	−0.11	−0.20	−0.02
Openness to experience	2	116	0.06	0.08	0.00	0.08	0.08	−0.11	0.26

[a] ρs are corrected for unreliability in predictor and criterion measures and direct range restriction.
[b] ρs are corrected for unreliability in the criterion measure.
[c] ρs are corrected for unreliability in predictor and criterion measures.
CV = Credibility interval. CI = Confidence interval.

conscientiousness. However, professional teams and student teams differ with respect to the effect of variability in emotional stability and openness to experience on team performance. The more similar student team members are in emotional stability and the more similar professional team members are in openness to experience, the better their teams perform.

DISCUSSION

Using meta-analytical procedures, we aimed at providing a more comprehensive answer than offered in previous studies to the question: How is team composition in terms of personality related to team performance? To answer this question, we discuss our findings and conclusions per trait. The second aim of this study was to signal directions for future research. These are presented throughout the discussion.

Extraversion

Neither elevation nor variability in extraversion influences team performance. For elevation this is in line with what we expected. For variability we expected a positive relationship with team performance, but although results were in the predicted direction (especially in the professional team sample), they were not significant. Based on our results we can only conclude that both elevation and variability in extraversion are not related to team performance.

Agreeableness

The higher the elevation of agreeableness in teams, the higher their performance. This finding is in line with a number of separate studies on the relationship between agreeableness and team performance (Barrick et al., 1998; Graziano et al., 1997; Neuman et al., 1999; Neuman & Wright, 1999; Van Vianen & De Dreu, 2001), but differs from individual level meta-analyses in which no relationship was found between agreeableness and performance (Hurtz & Donovan, 2000). It seems that agreeableness does not come into play until people have to work together. Results by Hurtz and Donovan (2000), who showed a positive relationship between individual agreeableness and individual interpersonal facilitation, are consonant with this expectation. So perhaps agreeableness asserts its effect on team performance through interpersonal facilitation within the team. This is a topic that should be addressed in future research. The fact that the effect of elevation in agreeableness was stronger in professional teams and virtually absent in student teams may have to do with the fact that professional teams cooperate over a longer period of time and members are more interdependent. As we speculated this requires more interpersonal facilitation (contextual performance), and thus the effect of elevation of agreeableness on team performance will be more salient in professional teams. The effect of variability in agreeableness was as expected. For all samples we found that the more similar team members are in this respect, the better their teams perform. In general, we can conclude that teams whose members score both highly (except for student teams) and similarly on agreeableness are the teams that perform best.

Conscientiousness

For conscientiousness we found that the higher the average levels of conscientiousness of teams are, the higher their performance is. This finding is in line with findings on the relationship between individual conscientiousness and individual performance (Hurtz & Donovan, 2000; Salgado, 2003), and with results of a number of individual studies on the relationship between conscientiousness and team performance (Barrick et al., 1998; Mohammed & Angell, 2003; Neuman et al., 1999; Neuman & Wright, 1999; Van Vianen & De Dreu, 2001). Moderation analysis shows that this effect is absent in student teams. Again this might be explained by the fairly short period of time task completion takes and the low levels of team member interdependency. Short project periods require little planning or systematic working towards goal completion, behaviours typical of people low in conscientiousness. Furthermore, similarity in background of students would make it possible for one–highly conscientious– team member to complete the task. Than, the maximum team score (Barrick et al., 1998) for conscientiousness would be the better operationalization to study when researching the effect of conscientiousness in student

teams. With respect to effects of variability of conscientiousness within a team, the results indicate that–for all samples–the more similar team members are, the better their teams perform. The general conclusion for this trait is that the best performing teams are those whose members score both highly (except for student teams) and similarly on conscientiousness.

Emotional stability

Contrary to expectations, elevation in emotional stability is not positively related to team performance. Maybe this relationship was not found because emotional stability is a too broad concept. Perhaps researchers should have tested for effects of facets within this trait. It may be that the self-confidence needed for effective teamwork (as hypothesized by Molleman et al. (2004) and Van Vianen & De Dreu (2001)) is better captured by the facets 'self-consciousness'which pertains to a person's social confidence) or 'vulnerability' or 'insecurity' (Saucier & Ostendorf, 1999), which pertains to a person's self-confidence (Costa & McCrae, 1992), instead of by the complete trait of emotional stability. As expected, variability in emotional stability is not related to team performance in the total sample. However, when comparing the professional and student team samples, opposite effects occur, of which only those of the student team sample are significant. For student teams there is a negative effect of both elevation and variability on team performance, but it has to be noted that the upper bound of the CIs of both effects is very close to zero. For professional teams both effects tend in a positive direction. These results may alter when meta-analyses are conducted with larger sample sizes. Given the small magnitude of effects at the general level and the opposing effects at the sub sample level, we restrain ourselves from drawing general conclusions for this trait.

Openness to experience

Elevation in openness to experience is not positively related to team performance, like we expected it to be. Elevation effects for both types of teams are in opposite directions (positive for professional teams and negative for student teams) but not significant. In line with expectations, variability in openness to experience is not related to team performance, although it is negatively related to team performance in the professional team sample. We think that the main explanation for the fact that these relationships are not as expected and different per sub sample for this trait is of a methodological nature: All effects found are based on relatively small sample sizes. It is not improbable that additional data may change these preliminary results. Therefore, we feel it is unjustifiable to draw general conclusions regarding openness to experience on the basis of the present results.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The main limitation of this meta-analysis is the small number of correlations from which population correlations were computed for some of the traits, especially in the moderator analysis. Hunter and Schmidt (2004) indicated that small samples in meta-analysis may lead to a second-order sampling error. This means that meta-analytical estimates of the standard deviations are affected (more than estimates of the mean, p.399). To avoid this

kind of error, more research on this topic is needed to be able to perform meta-analysis on larger samples.

Another limitation might be that two studies used slightly different operationalizations of elevation and variability. For elevation, Barry and Stewart (1997) used proportions of high scoring team members, whereas the other studies used means or sums. For variability, Mohammed and Angell (2003) used standard deviation scores whereas the other studies used variance scores. This may have had an influence on the results of the total sample. It is, therefore, important that in future studies researchers use similar operationalizations of team composition in terms of personality. Bedeian and Mossholder (2000) proposed to use mean and standard deviation scores to test for variability effects (cf. Mohammed & Angell, 2003).

A final limitation was our inability to determine the exact cause of the moderating effects for professional- and student teams, because explanatory variables covaried in the sub samples included in the moderator analysis. We present our conclusions with reticence, but even so, our inability to test for moderator variables separately may have led us to draw oversimplified conclusions. This limitation brings us to another important suggestion for future research: the effect of possible moderators should be tested independently. Given our preliminary explanation for the differences found, unravelling effects of the period of time team members cooperate and interdependency among team members may be given priority when studying moderator variables in professional and student teams.

These limitations notwithstanding, the integration of the results we offer holds important information about the relationship between team composition in terms of personality and team performance. The substantial main effects of the elevation and variability of conscientiousness and agreeableness, and the absence of such effects for other traits (elevation in extraversion, and variability in emotional stability and openness to experience) hold important consequences for team composition in practice. Preferably, teams should be composed of members that are highly and similarly agreeable and conscientious. This means that in the selection process of future team workers personality should be considered as one of the selection criteria. Furthermore, future team composition researchers should be aware of the differences between professional and student teams and the covariation of multiple moderator variables in both types of team. This knowledge should make them select the teams they intend to study with extra care.

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