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Running Head: PERSONALITY FACTORS AND TEAM PERFORMANCE

Personality and Team Performance: Implications for Selecting Successful Product Design Teams [1]

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Abstract

This exploratory experimental study investigated the relationship between scores on the "Big Five" personality factors (Extraversion, Conscientiousness, Neuroticism, Agreeableness, and Openness to Experience) received by members of a design team and the team's subsequent performance and satisfaction. The study provided some interesting results from which "preliminary rules" for the selection of team members might be made.

Personality and Team Performance: Implications for Selecting Successful Product Design Teams

In new product development, time is one of the biggest potential costs in the product development cycle. In fact, it has been suggested that products which meet their budget but are late coming to market generate substantially less profit than those going over budget but coming to market on time (Gupta & Wilemon, 1990). In light of the importance of product development timeliness to the ultimate success of the product, and hence the organization, there is a demand for faster and more efficient new product development (Maidique & Zirger, 1984; McDonough III & Barczak, 1992). Project organization, or more specifically, the use of cross-functional teams which are accountable for the project from beginning to end has been identified as one of the strongest determinants in project timeliness (Cooper, 1994; Cooper & Kleinschmidt, 1994; Cooper & Kleinschmidt, 1993; Larson & Gobeli, 1988; Peters, 1987; Perry, 1990).

One of the first logical steps in implementing product development teams is selecting the optimal members for the team. Selection, or manipulating the team's composition prior to the project, allows the team's probability of success to be maximized in a cost-effective manner. It has already been recognized by many organizations and researchers that a carefully selected team is vital to the success of the product, while a poorly chosen team invites chaos, disaster, and inferior technical performance (Kezsbom, 1992; Lane, 1987; Rideout, 1986). In order to use selection procedures in a responsible and effective manner, it is first necessary to determine the team member characteristics of the optimal development team.

Factors such as group cohesiveness (Keller, 1986) and "cognitive problem-solving orientation" (McDonough III & Barczak, 1992) have been suggested to characterize successful

product development teams. However, these factors are secondary factors. That is, they may be expressed as functions of individual characteristics or combinations of team member characteristics. Group cohesiveness is only possible if the behavioural tendencies of the team members are compatible at some minimal level that allows interpersonal interaction to occur without destructive interpersonal conflict. "Cognitive problem-solving orientation" (CPSO) is simply a reflection of the propensity of a person to pursue the solution to a problem in a certain manner (e.g. searching for novel solutions versus adhering to commonly accepted ways of doing things). In other words, CPSO is an indicator as to how we can expect a certain person to behave when confronted with a problem or task.

The propensity of a person to behave in a certain manner, or to successfully interact with others, is a function of his or her personality (Hogan, 1991). Thus, if we can determine the personality combinations of team members that contribute to, or inhibit team performance, we can maximize our chance of product development success by simply administering a commercial personality test prior to team formation.

This study attempts to etch a starting place for future research in personality as a predictor of team success for a product design team and to provide some preliminary rules in the selection of product design teams. The "Big Five" personality taxonomy, which summarizes all personality traits into five factors ("Conscientiousness", "Extraversion", "Agreeableness", "Emotional Stability", and "Openness to Experience"), will be used as a framework to organize the existing literature as well as the findings from this study.

Personality as a Predictive Device

Personality traits are relatively enduring characteristics of individuals which are not easily changed by interventions such as behavioural training (Helmreich, 1984). Although there is multitudinous research on personality, most of it is in the clinical psychology literature and deals with the relationship of personality type with abnormal behaviour. There has been relatively little effort put forth to determine the personality factors associated with exceptional job performance (Driskell, Hogan, & Salas, 1987). As well, there is little consensus on the personality test/scale that should be used, making comparison across studies difficult. However, there has been some work in developing an overall classification system for personality traits. "The Big Five" ("Extraversion", "Emotional Stability", "Agreeableness", "Conscientiousness", and "Openness to Experience") classification system which will be described in greater detail later in the paper, has received the most support (Barrick & Mount, 1991; Digman, 1990; Tupes & Christal, 1961; Norman, 1963; Goldberg, 1990; McCrae & Costa, 1987; Digman & Inouye, 1986) and will be used as a comparator in this study.

Several researchers have suggested that team member personalities may be useful as a predictive device for future performance (Cattell, 1951; Golembiewski, 1962; Hackman & Morris, 1975; Ridgeway, 1983). However, there are also many opponents to this notion (Kahan, Webb, Shavelson, & Stolzenberg, 1985; Mann, 1959; Sorenson, 1973; Whyte, 1941). Those who are pessimistic about the usefulness of personality tend to refer to studies done in the 1950's which attempted to make sweeping generalizations about personality traits to a wide array of situations. Current reviews and meta-analyses using more sophisticated analysis techniques, a consistent

taxonomy of personality traits (e.g. the "Big Five"), and specific performance criteria (George, 1992) suggest that there is potential to use personality measures as selection devices.

Research in the personnel selection literature indicates that if relevant personality factors are identified for a specific job or role, future performance can be predicted (Barrick & Mount, 1991; Borman, Rosse, & Abrahams, 1980; Day & Silverman, 1989; Lord, DeVader, & Alliger, 1986; Tett, Jackson, & Rothstein, 1991). Extending this logic into the realm of teams, if relevant personality traits are identified for a specific team task, the personality profile of the team might be helpful in predicting future team performance (Driskell, Hogan, and Salas, 1987). The application of such knowledge would help organizations to maximize the effectiveness of the team simply by ensuring that the personality profile of the team (e.g./ the combination of team member personality factors) matched the requirements of the task (Klimoski & Jones, 1994). After reviewing much of the team personality literature, Driskell et al. (1987) proposed various hypotheses relating Hogan's six personality factors (Hogan uses four of the "Big Five" factors: "Agreeableness", "Openness to Experience", "Emotional Stability", and "Conscientiousness" and splits "Extraversion" into "Sociability" and "Ascendancy") to certain task types. The hypotheses that were proposed relating team member personality factors to team performance for optimizing tasks (those tasks where more than one possible solution exists and the team's mandate is to optimize the product/solution produced) are included below in the discussion under the appropriate personality factor. Although Driskell et al. did not directly propose how to operationalize the team's personality profile, they suggested that "any single individual or composite of individuals can be described in terms of these dimensions [Hogan's six personality

factors]" (pg 99) suggesting that each personality factor should be considered separately and that a combination of scores on the factors may be used.

The use of personality in the realm of team staffing is more complex than simply using it as a predictive device for a particular job. Not only must the personality profile of the team match the demands of the task, the people on the team (and hence, their personalities) must be compatible. Organizations are beginning to realize the importance of considering personality mixes when designing self-managed work teams. For example, at Eastman Kodak, teams were constructed using the best technical people available. However, despite the attention to ability level, sometimes the teams were successful and sometimes they were not. Once the company started to take personal compatibility into account when organizing teams, the teams have had a higher success rate (Moad, 1994). Thus, personality seems to make definite contribution in helping organizations to staff effective teams.

Review of the "Big Five" literature

The studies relating team member personality to team performance is sparse. Most of the studies that do exist measure and relate specific personality traits (which compose a minute piece of one of the five factors) to team performance or team satisfaction. There is no replication of any of the results due to the task specificity and the situational nature of the experiments. There are therefore no specific conclusions relating personality, as classified within the "Big Five" framework, to team performance. However, the preliminary results from the studies in existence indicate that some personality traits may affect performance for certain tasks in certain situations

(Driskell, Hogan, & Salas, 1987). A brief overview of the findings to date for each factor is described below.

Conscientiousness. A person displaying the factor of "Conscientiousness" has been described as being dependable, careful, thorough, responsible, organized, planful, hardworking, persevering, and achievement-oriented (Barrick & Mount, 1991; Digman, 1990). In the personnel selection research, the factor "Conscientiousness" has been shown to be a valid predictor of future job performance for all occupational groups (Barrick & Mount, 1991; Tett, Jackson, Rothstein, & Reddon, 1994). Given that each person in the team is performing his/her job by participating in the team task, it is logical that the factor of "Conscientiousness" may also be related to the task performance of the group. This extension of logic is also supported by recent findings by Thoms, Moore, and Scott (1995) which show that "Conscientiousness" is positively related to self-efficacy (which the authors contend is predictive of performance) for participation in self-managed work groups.

Other support for the contention that the level of "Conscientiousness" of the members in the group may be related to group performance can be found by the studies that have related the groups' need for achievement with their subsequent performance on a task. Groups whose members showed a high need for achievement outperformed groups whose members had a low need for achievement (French, 1958; Schneider & Delaney, 1972; Zander & Forward, 1968) on a variety of tasks. Leadership orientation was also found to correlate positively with group performance (Shaw & Harkey, 1976). In addition to this, Driskell, Hogan, and Salas (1987)

propose that "ambition" (which includes "need for achievement") may be predictive of team performance for a variety of tasks.

It should be noted that there is some controversy over the classification of the term "achievement oriented" or "need for achievement" included in the "Conscientiousness" definition above. Hough (1992) found that "need for achievement" loaded on both the factor of "Ambition" (which is part of the Big Five "Extraversion" factor) as well as the Big Five factor of "Conscientiousness". However, the traits given as representative of the "Extraversion" factor (sociable, gregarious, assertive, talkative, and active) do not suggest that "achievement-orientation" is a necessary part of this construct, whereas traits associated with "Conscientiousness" (hardworking and persevering) do. Thus, literature that investigated the "need for achievement" or "achievement orientation" factor in relation to team performance was interpreted as evidence for the relationship between the "Conscientiousness" factor and team performance.

Hypothesis 1: The team's level of Conscientiousness will be positively related to the performance of the team.

Extraversion. "Extraversion" is exemplified by such traits as sociability, gregariousness, assertiveness, talkativeness, and activeness (Barrick & Mount, 1991; Digman, 1990). In the individual personnel selection literature, "Extraversion" has been shown to have positive validity in predicting future individual job performance for those occupations that have a large social component (Barrick & Mount, 1991; Tett, Jackson, Rothstein & Reddon, 1994). Given that an optimizing task performed as a team requires frequent social interactions among the members, it

may be argued that the factor of "Extraversion" could be related to the team's performance for an optimizing task. The research that has been done with respect to components of "Extraversion" in the realm of the team environment has been diverse.

Dominance, (which is closely related to the factor of "Ambition" (Hogan, 1986), which in turn loads on the factor of "Extraversion" (Hough, 1992) has been shown to be positively related to the performance of the group (Altman & Haythorn, 1967; Bouchard, 1969; Driskell, Hogan & Salas, 1987; Ghiselli & Lodahl, 1958; Haythorn, 1953; Shaw & Harkey, 1976; Smelser, 1961; Williams & Sternberg, 1988) as well as the degree of participation within the group (Mann, 1959; Watson, 1971).

The level of "Sociability" (which is part of "Extraversion" according to Hogan, 1991) of group members has been shown to relate positively to team performance (Bouchard, 1969; Shaw, 1971). In addition, an early review of studies relating personality factors to team characteristics by Mann (1959) reported a positive relationship between the factor of "Extroversion" (which consisted of "Sociability" and "Surgency") and the degree of group member task-related participation.

The degree of participation within the group is usually operationalized as the amount of talking done by each group member. Williams & Sternberg (1988) found that both the average amount of talking done by members of the group and the maximum amount of talking done by any member of the group was positively correlated with the performance of the group.

The factor of "Extraversion" as measured by the Eysenck Personality Questionnaire was not found to correlate significantly with team performance (Williams & Sternberg, 1988).

However, Thoms, Moore, & Scott (1995) found that "Extraversion" as measured by the NEO-FFI (Costa & McCrae, 1992) was positively correlated with self-efficacy (and hence performance - according to Thoms et al. 1995) for participation in self-managed work groups.

Most of the evidence seems to suggest that there should be a positive relationship between the factor of "Extraversion" and team performance. Thus,

Hypothesis 2: The team's level of Extraversion will be positively related to the performance of the team.

In a preliminary study by Kichuk (1996), the composite level of "Extraversion" was not found to correlate significantly with group performance (although this may have been attributable to limitations in sample size). However, the composite was found to be positively related to self-reported performance in design teams.

Hypothesis 3: The team's level of Extraversion will be positively related to the team's self-reported performance.

Neuroticism. The factor of "Neuroticism" may also be thought of as a lack of "Emotional Stability", or "Adjustment" (which is the degree to which one exhibits "Emotional Stability"). "Neuroticism" is characterized by traits such as anxiety, depression, anger, embarrassment, emotionality, and insecurity (Barrick & Mount, 1991; Digman, 1990).

In the personnel selection research, "Emotional Stability" was not found to be correlated with future performance. Barrick & Mount (1991) hypothesized that once a certain threshold of stability had been attained by the person tested, the degree of "Emotional Stability" was no longer relevant in predicting performance.

However, in the realm of groups or teams, both Mann (1959) and Heslin (1964) claimed that "Adjustment" was one of the best factors in predicting group performance. Others also noted that "Emotional Stability" or lack of nervous tendencies was positively correlated with group effectiveness (Haythorn, 1953; Greer, 1955; Mann, 1959; Shaw, 1971) and distinguished leaders from nonleaders (Cattell & Stice, 1954; Richardson & Hanawalt, 1952). "Neuroticism" was also found to be negatively related to self-efficacy (and performance) for participating in self-managed work groups (Thoms, Moore, & Scott, 1995). Driskell, Hogan & Salas (1987) hypothesized that "Emotional Stability" should be positively correlated with group performance for all tasks. In sum, the consensus seems to be that "Emotional Stability" should be positively correlated with subsequent group performance, or, that "Neuroticism" should be negatively correlated with subsequent group performance. Hypothesis 4: The composite level of "Neuroticism" will be negatively related to the team's performance

Agreeableness (Likability). A person exhibiting traits included in the "Agreeableness" factor is courteous, flexible, trusting, good natured, cooperative, forgiving, soft-hearted, and tolerant. The results linking "Likability" with group performance are not consistent across studies. Most studies did not find a significant relationship between group member likability and performance or productivity (McGrath, 1962; Berkowitz, 1956; Tziner & Vardi, 1982; Haythorn, 1953; Terborg, Castore, & DeNinno, 1976), while some found a negative correlation between likability and performance (Adams, 1953; Weick & Penner, 1969; Bass, 1964). Positive relationships between social insight and group performance (Bouchard, 1969), "Agreeableness" and self-efficacy for working in self-managed work groups (Thoms, Moore, Scott), and the

person-orientation of the team leader and team satisfaction (Stogdill, 1974) have been found. From these results, Driskell, Hogan, & Salas (1987) hypothesized that "Likability" would only be positively related to performance on social (e.g./ training, assisting, or serving others) and manipulative/persuasive (e.g./ organization or motivation of others) tasks. Given the intellectual nature of the optimizing task, it is not known if the factor of "Agreeableness" will be related to team performance and thus no hypotheses are proposed.

Openness to Experience. This factor of the "Big Five" is also commonly referred to as "Intellect". Of the five factors, "Openness to Experience" is the least well defined. Traits associated with this factor include imagination, culture, curiosity, originality, broad-mindedness, intelligence, and artisticness (Barrick & Mount, 1991).

The personnel selection literature proposes that the factor "Openness to Experience" is predictive of a person's training proficiency (Barrick & Mount, 1991), however, it was not found to be predictive of job performance. It is not clear whether the "Openness to Experience" displayed by the team members has any relationship to team performance. The relationship between "Openness to Experience" and team performance will be investigated in an exploratory manner.

Heterogeneity of Personalities

Relationships between the "team level" (composite score, or sum of all team member scores) of a personality construct and team performance implicitly assumes that there is a compensatory relationship between the personality factor being tested and subsequent team performance. That is, if a factor is positively correlated with the task demands, that low scores of

some individuals on the factor can be compensated for by high scores on the same factor by other team members. This may prove to be an extremely limited and simplified view of personalities. In a team, compatibility in personality between members is an important contributory factor in the productivity of such groups (Moos & Speisman, 1962). The Fundamental Interpersonal Relations Orientation (FIRO-B) scale (Schutz, 1958) was an early attempt to measure the compatibility of dyads on three dimensions (affection, inclusion, and control). The scale itself has received mixed support over the years with the most recent research indicating that there are only two real factors instead of six. However, the major contribution of the scale was the recognition that differences in some personality dimensions are beneficial to the functioning of a team. Thus, this study will investigate the relationship between personality differences among team members and the effect that these differences have on the subsequent performance of the team.

The studies that have considered heterogeneity of team member personalities in terms of subsequent team performance have produced conflicting results.

One line of thinking is that a mix of personality types is necessary to optimize the performance of the team (Pitcher, 1993) especially when the task characteristics are diverse (Nieva, Fleishman & Rieck, 1978; Pearce & Ravlin, 1987). A few studies have looked at the interaction of team member personalities in relation to team performance. Teams (tetrads) composed of members with heterogeneous personality profiles (pairs of team members had both high positive and high negative Kendall's taus or near-zero Kendall's taus in terms of the ten-score profiles of the Guilford -Zimmerman Temperament Survey) outperformed those with

members who had homogeneous personalities (the Kendall's taus of each pair on the team was highly positive) on several optimizing tasks (Hoffman, 1958; Hoffman & Maier, 1961).

In the alternative, heterogeneity of individual characteristics offers breeding grounds for interpersonal conflict detrimental to team performance (Hoffman & Maier, 1961). Similarity theory supports this stance. Similarity theory argues that homogeneity of group members is desirable since it evokes positive forms of mutual attraction while heterogeneity introduces divisive tensions (Tziner, 1985). The implications of such an outlook is that workers placed in dissimilar groups in terms of members' personality orientations may have shorter tenure in the group and may ask to be transferred to a more compatible group (George, 1990) thus interrupting the productivity of the group.

The fact that completely opposite views have been generated with respect to the relationship between heterogeneity and team performance may be explained by the team's task and the personality factors studied. That is, heterogeneity may be beneficial for some tasks and not others. In the Hoffman (1958) and the Hoffman & Maier (1961) studies, an optimizing task was used. This seems to suggest that heterogeneity of group member personality may be beneficial for optimizing tasks. It is incorrect to generalize these findings to other types of tasks. Driskell, Hogan, & Salas (1987) make it very clear that different personality factors are important for different task types. The benefit or detriment derived from team member heterogeneity on these personality factors is therefore also likely to differ with the type of task undertaken (Collins & Guetzkow, 1964; Williams & Sternberg, 1988). The two studies in question also did not consider heterogeneity on specific personality factors, rather, heterogeneity was defined as

differences among personality profiles as a whole. This, in effect, treated all differences in personality as equal in their contribution to team performance. Although in the aggregate, heterogeneity was shown to be beneficial in this case, it is more likely that heterogeneity on some factors may be beneficial, while homogeneity on other factors may be necessary to ensure team harmony and productivity (Belbin, 1981). This was found to be the case in an exploratory study by Kichuk (1996). Heterogeneity of member scores on the factor of "Extraversion" was found to be negatively related to the team's performance while heterogeneity on the factor of "Emotional Stability" was found to be positively related to subsequent team performance. Although a significant relationship between the heterogeneity of member scores on these two factors in relation to team performance was found, the sample size in the Kichuk study for this relationship was small. Since this evidence does not provide enough support by itself to propose hypotheses, the relationship between the heterogeneity of team member scores on the personality dimensions and the team's performance will be investigated in an exploratory manner.

Method

This experimental study required the subjects to complete an Engineering Design task in a laboratory setting within a specified time limit. The subjects were administered a standardized general ability test, a personality test, a satisfaction questionnaire and a demographic profile (gender and age only). A laboratory design was used to control for extraneous factors (e.g./ organizational politics, status differences) so that effects attributable to the personality variables under investigation would be more obvious (Driskell & Salas, 1992).

Subjects

The subjects were 419 first year undergraduate Engineering Students enrolled in a problem-solving course. Twenty percent of the subjects were female. The subjects ranged in age from 16 to 32 years of age with the median age being 19 years.

The students were assigned to one of eight sections consisting of approximately fifty to sixty students each based on scheduling constraints. Within these sections, students were randomly assigned to teams of three for the design exercise. Completion of the design exercise and the self-analysis measures were a mandatory part of the course. However, participation in the study was contingent on the students voluntarily providing the researcher with demographic information. Of the 139 groups theoretically possible, the number of usable groups (depending on the dependent variable being investigated) ranged from 99 to 116.

Engineering Product Design Task

The task which the teams were asked to perform was to design and build a bridge from a limited amount of newspaper and tape which were provided. The bridge was required to span the space between two chairs or tables (standing upright) which had to be at least two feet apart. The bridge could not be affixed in any way to the tables or chairs. It was to rest on top of these surfaces only. The students had 45 minutes to complete the task. Points were awarded based on the bridge's span, uniform width, height (as measured from two points on the base of the bridge) and strength. Bonus points were awarded for teams who finished under the time limit. Bridge dimensions were scored prior to the strength test. The strength of the bridge was determined by its ability to support a two pound book being placed on it and dropped from various heights.

Once strength testing commenced, the team was not allowed to touch the bridge. Points were awarded for each drop the bridge withstood. Each team was given the scoring key before the task began. The overall objective of the task was to maximize the points obtained. Each team received an identical amount of resources with which to build the bridge.

Procedure

The students were randomly assigned to teams of three within classes whose composition was based on scheduling constraints. This was done in the first week of the semester of the first year. It is therefore unlikely that any of the students knew their team-mates well or had any experience working in a team with the other students (thus mitigating the effect of previous social relationships on the team's process and performance).

Teams consisted of three members for this exercise because of the difficulty of the task and the time allotted. Many authors have claimed that groups need to be large enough to accomplish the work assigned to them, but when too large, groups may be dysfunctional due to heightened coordination rules (Gladstein, 1984; O'Reilly & Roberts, 1977; Steiner, 1972; Campion, Medsker & Higgs, 1993). A previous study (Kichuk, 1996) determined that teams of three would be able to accomplish the task in the 45 minutes allotted.

The students were administered the personality test, the satisfaction/self-reported performance questionnaire and the demographic profile during class time.

At the beginning of the period, each team was given a description of the task, the material required to construct the bridge, and the scoring key. The students had 45 minutes from this point to construct the bridge. The scoring key was designed so that there were competing

constraints on the bridge. The team-mates had to strategize how to build the bridge to maximize the points. There was no one superior strategy. However, significant planning was required to maximize the points attained. After the time was up or the team had finished the bridge, the bridge was scored by specially trained research assistants and the team members were asked to complete a satisfaction questionnaire about their product and the process employed.

Although measures of inter-rater reliabilities are traditionally provided when products are evaluated by external "experts", the nature of this task did not require such a precaution for several reasons. First, the bridge was evaluated in terms of a pre-set scoring guide that assigns points as a function of the length, width, height, and strength of the bridge. These dimension measures (e.g./ length, width, and height) were taken with measuring tapes that are accurate to within 1/16th of an inch. Points were assigned in 1-foot increments. Thus, there were no "judgment calls" in assigning points to the measures taken. Second, there were two people on each measuring team. One person measured while the other watched and recorded the measurements. Thus, any mistakes in the measurements made by the Measurer were likely to be caught by the Recorder. In addition to the watchful eye of the Recorder, spectators from both the team whose bridge was being measured and from rival teams were likely to catch any mistakes made by the Measurer. The most subjective part of the point assignment was the strength test. The multiple spectators were likely to catch any inconsistencies made by the Measurer, however, in this case, multiple tests (as would be required for inter-rater reliabilities to be calculated) were not possible since the bridge's integrity was diminished with each weight dropped on it.

Measurements

Team performance was measured by the team's actual score obtained on their bridge in accordance with the scoring scheme shared with the teams prior to the task.

General mental ability was measured using Form IV of the Wonderlic Personnel Test. This short (12 minute) test of general cognitive ability includes items in vocabulary, "commonsense" reasoning, formal syllogisms, arithmetic reasoning and computation, analogies, perceptual skill, spatial relations, numerical series, scrambled sentences, and knowledge of proverbs. The primary factors measured are verbal comprehension, deduction, and numerical fluency (Foley, 1972; Gatewood & Feild, 1994; Wonderlic Personnel Test Booklet, 1992). The advantage of using the Wonderlic Personnel test is that it is short and has been normed on various populations over a long period of time (since 1938) and has been extensively tested in terms of validity and reliability. General mental ability was used as a control variable.

Team member personality was measured using the NEO-FFI (which is a shortened version of the NEO-PI) personality test (Costa & McCrae, 1992). This test has been recommended by Hogan (1990) as a good measure of the Big Five personality dimensions. In a review of this test for the Eleventh Annual Measurements Yearbook, Widiger concluded that "any study that purports to be addressing fundamental dimensions of personality should include the NEO-PI as a measure" (pg 606). The NEO-PI has reported alpha coefficients across the facets measured ranging from 0.61 to 0.79 for men and 0.60 to 0.82 for women (Hess, 1992). Both Hess (1992) and Widiger (1992) both refer to the NEO-PI as having "impressive" validity. The NEO-FFI used in this study is a shortened version of the NEO-PI. Gender was measured using a dichotomous

scale (M/F). Team member satisfaction was measured by six questions using a Likert 5 point scale tapping into the team members' satisfaction with their product, process, and people. Questions included: "I am satisfied with the quality of the product our group produced"; "I am satisfied with the degree to which our product matched the requirements of the exercise"; "I am satisfied with the process our team employed in creating our product"; "I am satisfied with the contributions of the other team members toward our team's product"; "Overall, I am satisfied with the performance of our team". This scale had an internal consistency reliability of 0.86. Factor analysis provided support for these items to be combined into an overall Satisfaction composite.

Self-reported performance was determined by two statements using a 5-point Likert scale asking the subjects to rate their performance in terms of the product produced : "The product that our team produced was of high quality" (SRP2); "I do not think that our team performed well" (SRP1). The responses for these two questions were not combined into a composite because they measure the team's perceived performance of two separate aspects of performance. SRP2 measures perceived quality of the team's product, while SRP1 measures perceived performance with the process. The internal consistency reliability of these two items ($r = 0.62$) were supportive of the contention that these two items measured related but different aspects of performance. The effect of personality on these two items were analyzed separately.

Team member propensity to work together in the future was measured using a Likert 5 point scale (Strongly agree to strongly disagree) on two statements: "I would like to continue working with this group in the future"; "I work well with this group" . The internal consistency

reliability for these two items was found to be 0.74. Thus, these items were combined into a composite of "longevity", or propensity to work together in the future.

Hypotheses made with regard to the effect of the team's personality on outcome variables (e.g. performance and self-reported performance) used the composite score of the team on the appropriate measure described above (i.e., simple addition of the team members' scores on the measurement of interest). Heterogeneity of team member scores was operationalized in terms of the standard deviation of scores on each of the independent measures.

Analysis

The frequency distribution of the actual group performance (e.g. group scores) indicated that two distinct subsamples could be derived from the overall sample distribution. The first subsample was a cluster of "zero scores" (ZS). The teams that received a score of zero (ZS) for the task at hand did so because they violated fundamental constraints that were clearly stated in the problem. That is, ZS teams were total failures - they were not able to produce a minimally acceptable product that could be evaluated. The second subsample consisted of a normally distributed curve of non-zero scores (NZS). Thus, the fundamental difference between these two sample subsets was that the NZS teams could function as a team, at least at some minimal level, whereas the ZS teams were total failures as design teams.

The existence of two such distinct subgroups within the sample indicated to us that the relationships between the personality variables and the dependent variables should be analyzed in two stages. The first analysis investigated the relationships between independent and dependent variables for the data set as a whole. The second analysis was done on the NZS and ZS subsets

separately. Correlations between the personality measures and the dependent variables were considered for only for the NZS sample subset since the secondary dependent variables (e.g. satisfaction, propensity to work together in the future, self-perceived performance) only become relevant if the team is minimally successful. In addition to examining the characteristics of each subsample, the differences between the two sample subsets were investigated in order to determine if the teams that were able to perform at or above the minimal level of competence differed significantly from those teams that were not able to achieve such status. Correlational analysis was done on the data using SPSS for Windows to both test the proposed hypotheses and to investigate new relationships.

Differences between the "zero" (ZS) and "non-zero" (NZS) scoring populations were tested via both a ONE-WAY ANOVA procedure and an ANCOVA procedure controlling for the ability of the group as measured by the Wonderlic Personnel Ability test.

Results

Conscientiousness

Hypothesis 1, which postulated that the team's composite level of Conscientiousness would be positively related to the team's performance, was not supported (see Tables 1 and 3). However, the heterogeneity of Conscientiousness among the team members was found to be significantly correlated with the team's performance for both the population as a whole (-.24, $p<.05$) and the "non-zero scoring" (NZS) (-.22, $p<.05$) population subset (see Tables 2 and 4). Neither the composite nor the standard deviation of the Conscientiousness factor was found to be significantly related to any other outcome variable investigated.

Insert Tables About Here

Extraversion

Hypothesis 2, which postulated that the composite level of Extraversion would be positively related to the actual performance of the team was supported for the full sample ($r = .20$, $p<.05$) but not for the NZS subsample.

Hypothesis 3, which stated that the team's composite level of Extraversion would be positively related to the team's self-reported performance was supported for the full sample (Table 1) (SRP1: $r = .29$, $p<.01$; SRP2: $r = .20$, $p<.05$) and partially supported for the NZS subset (Table 3) with Extraversion being significantly related to self-reported team performance (SRP1: $r = .22$, $p<.05$) but only less stringently related to self-reported product performance (SRP2: $r = .18$, $p<.10$).

The composite of Extraversion was found to be significantly related to both satisfaction and the potential longevity of the team for the full sample ($r = .29$, $p<.01$; $r = .23$, $p<.05$ respectively) and the NZS subset ($r = .22$, $p<.05$; $r = .22$, $p<.05$). There were no relationships between the measure of heterogeneity of Extraversion and any of the outcome variables for the NZS sample subset.

Neuroticism

Hypothesis 4, which predicted that the team's composite of Neuroticism would be negatively related to the team's performance was not supported. In fact, the composite of

Neuroticism was not found to be significantly related to any of the outcome variables at the traditional $p<.05$ level. However, given the exploratory nature of this study, relationships that met the less stringent $p<.10$ level were investigated. When the full sample was considered, Neuroticism tended to be negatively related to the Group score ($r = -.19$, $p<.10$), the team's level of Satisfaction ($r = -.17$, $p<.10$), and the team's self-report on team performance (SRP1: $r = -.17$, $p<.10$). These relationships did not exist when the NZS subset was considered.

Agreeableness

The only significant relationship with respect to the composite of Agreeableness was that between the Agreeableness composite and the team's self-reported performance (SRP1: $r = .23$, $p<.05$) for the entire sample. There were no relationships between the composite of Agreeableness and any outcome variables for the NZS subset.

The heterogeneity of the Agreeableness factor was found to be significantly and negatively related to the propensity of the team to work together in the future in both the full sample ($r = -.23$, $p<.05$) and the NZS subset ($r = -.22$, $p<.05$).

Openness to Experience

The composite of Openness to Experience was found to be positively and significantly related to the teams' self-reported performance (SRP1: $r = .23$, $p<.05$) when the full sample was tested, however, the significance of this relationship declined when only the NZS subset was considered (SRP1: $r=.20$, $p<.10$). There were no other apparent relationships between the Openness to Experience factor and any of the outcome variables.

Differences Between the NZS and ZS Subsets

There were no significant differences between the NZS and ZS subsets on the composites of Conscientiousness and Openness to Experience. As well, no significant differences between the two subsets occurred for any of the heterogeneity (standard deviation) of personality measures.

However, significant differences were found between the two subsets for the composites of Extraversion, Neuroticism, and Agreeableness.

The teams in the NZS subset scored significantly higher on the Extraversion factor than did the ZS subset (M_{NZS} = 94.3 vs M_{ZS} = 86.5, F (1, 100) = 6.12, $p<.05$). This difference was also found to be true when the teams' ability level was controlled (F (1, 96) = 3.9, $p<.05$).

The ZS and NZS subsets differed substantially on the factor of Neuroticism. Those in the ZS subset tended to score higher than those teams in the NZS subset (M_{ZS} = 68.6 versus M_{NZS} = 55.7, $F(1, 100) = 11.95$, $p<.01$). This difference was also apparent when the teams' ability levels were held constant ($F(1,96) = 7.35$, $p<.01$).

The composite of Agreeableness was found to be significantly higher in the NZS subset than the ZS subset (M_{NZS} = 98.4 vs M_{ZS} = 89.7, F (1,99) = 6.97, $p<.01$), however, the significance of this difference declined when the effect of the teams' ability levels was considered (F (1,96) = 3.1, $p<.10$).

Discussion

Although there seemed to be many significant relationships between the personality factors and the dependent variables in the total sample (e.g. both ZS and NZS subsets together), upon examination of the graphs depicting these relationships, it became apparent that the presence of the ZS subset often contributed to significant correlations when the relationship was not meaningful. As stated previously, teams in the ZS subset were not able to produce a minimally acceptable product - in other words, the teams were total failures. The presence of a relatively large (ZS = 13% of the entire sample) subset of these "failures" weighted heavily on the correlational analysis. Since we were interested in determining how personality variables related to differences in performance, and the ZS subset did not perform to an adequate level so that differences in performance could be discerned, the inclusion of the ZS sample in the entire sample for the purpose of examining the relationships between the independent and dependent variables may be misleading. Thus, the discussion will focus on the results for the NZS subset.

The significant relationships that did occur in the NZS sample subset are depicted in Tables 3 and 4. The composites of Neuroticism, Agreeableness, and Conscientiousness were not found to significantly impact on any of the team outcome variables. Composites for both the factor of Extraversion and Openness to Experience were found to have significant correlations with the team's self-perceived team process performance. The Extraversion factor also correlated significantly with the team's satisfaction, self-reported product performance, and propensity to work together in the future.

The above results with respect to the factor of Neuroticism do not seem to directly support previous evidence from the small group literature which associated Neuroticism with poor team performance. However, the results do collaborate the threshold hypothesis put forth by researchers in the individual personnel selection literature (which will be discussed later in this section).

The lack of relationship between the composite of Agreeableness and the outcome variables is in keeping with the lack of previous substantive evidence in both the small group and individual personnel selection literature linking this variable with task/job performance. Thus, the factor of Agreeableness does not seem to be related to team performance for teams that are capable of adequate performance.

The lack of relationship between the composite of Conscientiousness and the team's performance was surprising given the evidence in the personnel selection research that Conscientiousness predicts future job performance for all occupational groupings (Barrick & Mount, 1991; Tett, Jackson, Rothstein, & Reddon, 1994). One possible explanation for the apparent lack of relationship between the Conscientiousness composite and the team's performance may be that the subjects under investigation in this study were new students and that the result of the task was part of each student's mark in the course. The relative novelty of being a university student and the perceived consequences of not performing well may have caused most students to behave conscientiously while doing the task regardless of how they scored on the personality profile. Another possibility is that the short time frame involved in performing this task may not have been sufficient to allow differences in Conscientiousness to manifest themselves

in differences in performance. Studies which follow design teams over a longer period of time need to be done in order to establish the long-term impact of personality on performance.

The composite of Openness to Experience correlated significantly ($p<.10$) with the team's perception of how they performed as a team (e.g. team process). Since teamwork is a relatively new way in which to organize work, and many first-year students may not have had previous experience working in teams, it may be argued that those who more readily accept new ways of working may be more optimistic with respect to their success in trying new work arrangements. However, the level of significance indicates that this finding should be replicated before any conclusions are drawn. This line of reasoning may be irrelevant in the work environment when teams are commonplace.

The composite of Extraversion, in accordance with hypothesis 2, was found to correlate significantly and positively with self-reported performance lending further support to the evidence from the small group research that participation within the group increases the perception of performance. The significant correlations with Satisfaction and potential longevity seem to also suggest that Extraverted people are happy in a group setting since it gives them a chance to participate in a social venue while working. Unfortunately, the composite of Extraversion bore no relationship to the actual performance of the teams. This suggests that teamwork may be an enjoyable method of work for Extraverted people, but it is not necessarily an effective one.

There were only two significant relationships between heterogeneity measures of personality factors and outcome measures. The first involved a negative relationship between the level of heterogeneity in Agreeableness and potential longevity of the team. The second was a

negative relationship between the measure of heterogeneity of Conscientiousness and the team's performance.

The relationship between the level of heterogeneity of Agreeableness and the potential longevity of the group implies that those teams made up of members that differed in their degree of "friendliness" may not have wished to continue working with the same people. Very friendly people may be offended by those who are less overtly friendly, or "down to business" people. Conversely, more serious people who are more critical and skeptical in their thinking (characteristic of those who score "low" on the Agreeableness factor) may view overtly friendly people as frivolous or insincere. Such an interaction may cause conflict detrimental to team performance and offers support for similarity theory on this factor. Therefore, when constructing teams, those with similar levels of "Agreeableness" may need to be matched up in order to maintain good relations.

People who score high on the Conscientiousness factor tend to be focused and achievement-oriented, while those scoring low on the factor may be more relaxed in applying the work ethic. Thus, one explanation for the negative relationship between the level of heterogeneity in the Consciousness factor and team performance may be that there is some conflict among the team members as to the urgency or importance of the task at hand. For example, those members with a high-achievement orientation may have become frustrated with other team members who were more relaxed in the execution of the exercise. These outlooks could have become apparent in a short time and could have conceivably surfaced during the relatively short design project done

in this study. Thus, in constructing a team, it may be a good idea to minimize the heterogeneity of the Conscientiousness factor so to minimize unproductive frustration and conflict.

As mentioned above, examination of the NZS and ZS sample subsets provided some clues as to what characteristics allow a team to function at some minimal level of competence. There were some significant differences found between the NZS and ZS subsets for some of the personality factors that offered some insight.

The two groups (NZS and ZS) differed most on the factor of Neuroticism. The teams that were part of the ZS group scored higher, on average, than did the teams in the NZS group (M_{ZS} = 68.82 versus M_{NZS} = 55.76) on this factor. This would imply that high composite scores on the factor of Neuroticism are detrimental to the team's performance. However, perhaps the most striking evidence of this is that 50% of the teams in the ZS group had scores in the top 10% of the total sample distribution for the Neuroticism composite. Upon further investigation, those teams scoring in the top 10% of the sample on Neuroticism had at least two members that scored "high" or "very high" on the Neuroticism factor as defined by Costa & McCrae (1992) for the population as a whole.

The above findings are in also line with the "threshold" hypothesis proposed by researchers in the individual personnel selection literature (Barrick & Mount, 1991). That is, there is a minimal level of Emotional Stability that is necessary for adequate functioning on the job, however, after this minimum level is attained, there is no relationship between incremental amounts of Emotional Stability over and above this threshold and performance. The fact that

50% of the teams in the ZS subset scored in the top 10% of the sample distribution implies that these teams were so lacking in Emotional Stability that adequate job performance was not possible. Furthermore, the lack of relationship between the composite of Neuroticism and performance for those teams able to build the bridge to an acceptable minimal standard (the NZS group) is in keeping with the lack of relationship between incremental amounts of Emotional Stability above the threshold and job performance found in the individual personnel selection literature.

Another factor on which the two subsets differed was the composite of Extraversion. Teams that were part of the NZS group scored higher, on average, than those in the ZS group (M_{NZS} = 94.3 versus M_{ZS} = 86.5). Although the Extraversion composite scores for the ZS group did not cluster in a narrow range as did the composite scores for Neuroticism, they were conspicuous by their absence in the top 35% of the distribution for the entire sample. That is, although there is no direct relationship between the composite of Extraversion and the team's performance for either of the sample subsets, it is interesting to note that teams in which the "average member" (defined for this purpose as the composite score divided by the three members) scored "very high" (as defined by Costa & McCrae, 1992 in terms of the population norm) on the Extraversion scale were not prone to failure.

The last independent variable on which the two sample subsets significantly differed was that of the Agreeableness composite (although after controlling for the teams' general ability level, this difference was only significant at the less stringent $p<.10$ level). Those teams in the NZS group tended to score higher, on average, than teams from the ZS group (M_{NZS} = 98.41

versus $M_{ZS} = 89.7$). Again, similar to the case of the Extraversion composite, teams from the ZS group were conspicuously absent from the top 35% of the sample distribution on the Agreeableness factor. In this case, if the "average member" (composite divided by number of members) scored at least "average" (as defined by Costa & McCrae, 1992) on the Agreeableness factor, the team was likely to perform at an adequate level.

The NZS and ZS groups did not significantly differ on any of the heterogeneity measures of the personality factors.

Implications for Managers

The results of the study are diagrammed in Figure 1. The above discussion is may be summarized by the suggestion of some very preliminary suggestions for the selection of design teams:

1. For long-term teams, it may be advisable that the team members have an adequate propensity to be Extraverted. This may contribute to on-going participation within the team and may contribute to the integrity of the team for the long term (e.g. satisfaction and propensity of the team members to work together in the future were found to be positively correlated with Extraversion).

2. Although a significant direct relationship between the composite of Extraversion and team performance was not shown, teams with "very high" levels of Extraversion seem to be able to achieve an adequate level of team performance, although teams that do not have a high level of Extraversion are not necessarily doomed to failure.

3. It might be useful to minimize the amount of heterogeneity among the team members in the factors of Conscientiousness and Agreeableness. This might mitigate potential frustrations among team members with respect to achievement-orientation and might allow the team to continue successfully over the long term.

4. Teams with members scoring at least in the "average" range for the Agreeableness factor may do better. Although the level of Agreeableness does not correlate directly with performance, teams whose "average member" scores in at least the average range of this factor tend to be able to perform at an adequate level.

5. Forming teams in which the majority of the members score above the population average in the factor of Neuroticism may be detrimental. Teams with two or more members (out of three) who scored very high on this factor were not able to function at an adequate level.

6. As long as the "threshold" of Emotional Stability is met within the team, additional increments of Emotional Stability (low Neuroticism) are not necessarily helpful to team performance.

Future Research Directions

The study described in this article etches a starting point for researchers to "map-out" team personality factors that may be indicative of future design team performance. However, as mentioned above, there are some limitations to the generalizability of these results. First, the "preliminary rules" that were suggested need to be tested on design teams that are engaged in projects over a longer time period. The short duration of the task used in this study may not have provided adequate time for some personality combinations to manifest themselves in performance

or satisfaction differences. It is therefore recommended that more involved design projects that require the team to work together over an extended time period be used to verify the results obtained in this study.

For preliminary rules investigating the relationship between team member personality combinations and team performance, the use of a laboratory design is acceptable. A laboratory design minimizes the effect of other potentially confounding variables so that any relationship between the independent and dependent variables may be isolated to a greater degree than is possible in a field environment (Driskell & Salas, 1992). However, in order for these preliminary rules to generalize to organizational design teams, studies need to be taken from the laboratory environment into actual organizations where other "real life" variables (e.g. organizational politics, reward systems, status differences, experience differences) impact on the team's ability to succeed in addition to personality. This will allow us to determine if the team's personality combination is still a major factor in determining the team's success when other factors are present.

The applicability of the results obtained in this study may be limited to design tasks or to similar optimizing tasks. As mentioned previously in the paper, personality combinations that affect team success may be dependent on the team's task (Driskell, Hogan, & Salas, 1987). Therefore, in order to develop a "personality map" for team success, team personality combinations need to be investigated for other types of tasks.

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Table 1

Correlations between Personality Composites and Outcome Variables (Entire Sample)

	Group Score	Satisfaction	SRP1	SRP2	Longevity
Neuroticism	-.19*	-.17*	-.17*	-.09	-.04
Extraversion	.20**	.29***	.29***	.20**	.23**
Openness to Experience	.07	.10	.23**	.02	.17
Agreeableness	.13	.21**	.21**	.14	.08
Conscientiousness	.14	.07	.18*	.03	.00

* p <.10 **p<.05 ***p<.01

Note. SRP1 = Self-reported Performance for Team process; SRP2 = Self-reported Performance for Team product.

n for the above correlation analysis ranges from 98 to 116 teams

Table 2

Correlations between Heterogeneity of Personality Factors and Outcome Variables

	Group Score	Satisfaction	SRP1	SRP2	Longevity
Neuroticism	-.07	-.04	-.08	-.02	-.13
Extraversion	-.05	-.08	-.01	-.08	-.11
Openness to Experience	.04	.01	.04	.01	-.12
Agreeableness	-.01	-.09	-.03	-.11	-.23**
Conscientiousness	-.24**	.00	-.02	.02	-.09

*p<.1 **p<.05 ***p<.01

Note. SRP1 = Self-reported Performance for Team process; SRP2 = Self-reported Performance for Team product.

n for the above correlation analysis ranges from 98 to 116 teams

Table 3

Correlations between Personality Composites and Outcome Variables - NZS Subset

	Group Score	Satisfaction	SRP1	SRP2	Longevity
Neuroticism	.00	-.06	-.15	-.02	-.02
Extraversion	.07	.22**	.22**	.18*	.22**
Openness to Experience	.03	.07	.20*	.03	.17
Agreeableness	-.02	.14	.13	.11	.08
Conscientiousness	.06	.00	.12	.00	-.04

* p <.10 **p<.05 ***p<.01

Note. SRP1 = Self-reported Performance for Team process; SRP2 = Self-reported Performance for Team product.

n for the above correlation analysis ranges from 93 to 99 teams

Table 4

Correlations between Heterogeneity of Personality Factors and Outcome Variables NZS Subset

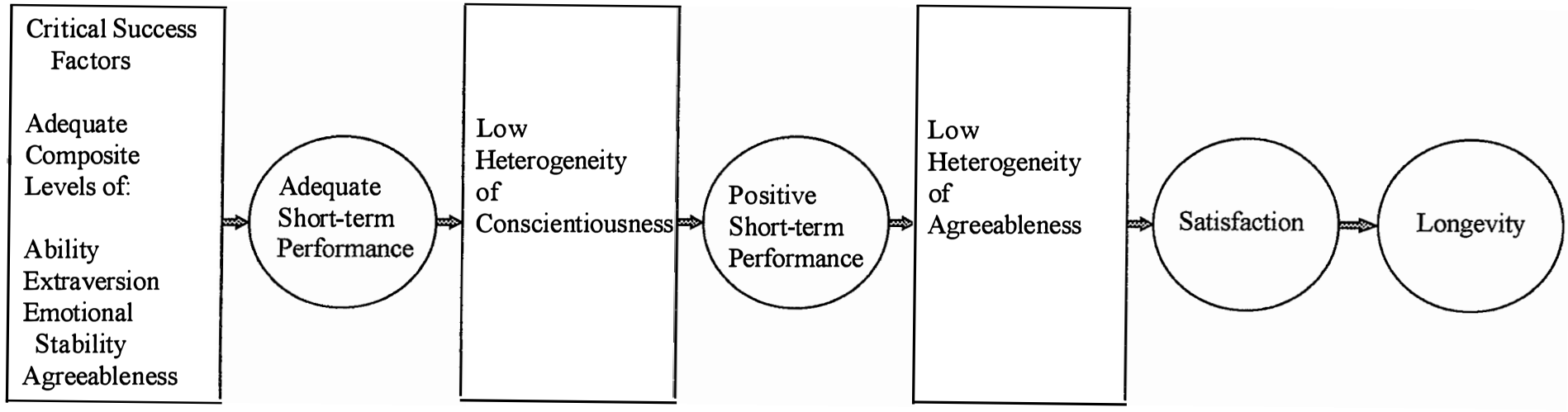
	Group Score	Satisfaction	SRP1	SRP2	Longevity
Neuroticism	-.10	-.01	-.05	.03	-.08
Extraversion	-.05	-.04	.02	-.06	-.06
Openness to Experience	.01	-.04	.02	.01	-.12
Agreeableness	-.03	-.16	-.11	-.17	-.22**
Conscientiousness	-.22**	-.06	-.06	-.08	-.12

*p<.1 **p<.05 ***p<.01

Note. SRP1 = Self-reported Performance for Team process; SRP2 = Self-reported Performance for Team product.

n for the above correlation analysis ranges from 93 to 99 teams

Figure 1- The Effect of Team Level Personality On Performance, Satisfaction, and Longevity



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