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The role of personality in new product development team performance

Richard R. Reilly*, Gary S. Lynn, Zvi H. Aronson

Wesley J. Howe School of Technology Management, Stevens Institute of Technology, Hoboken, NJ 07030, USA Accepted 12 November 2001

Abstract

Although the role of personality in team performance is not well understood, research suggests that personality plays a critical role in the effective performance of teams. Personality variables should be especially important for new product development (NPD) teams which typically include highly coordinated activities among multidisciplinary members. The five-factor model provides a consistent structure for understanding how personality relates to different kinds of behavior and is used as a framework for reviewing literature related to team performance. The same model is then used to form a set of research propositions that can serve to guide future research on the role of personality in NPD teams. Because the literature suggests that the role of personality is dependent upon the type of task involved, we differentiate our research propositions for two specific types of new product development: incremental innovation and radical innovation. We offer research propositions for the average level of each of the five-factor model variables and performance in the two types of teams. Finally, we suggest a set of research propositions for the effect of heterogeneity of personality on performance in radical and incremental innovation teams. © 2002 Published by Elsevier Science B.V.

Keywords: Personality; Teams; New product development

1. Introduction

Understanding what makes teams effective has never been more important than today when organizations are increasingly looking to teams as a solution to business problems. This is especially true of product development teams, whose members often have diverse backgrounds and competencies. The behavior of individual team members can enhance or impede team performance. Interpersonal conflicts, poor communication, lack of team cohesiveness and disagreement over goals are some of the behavioral consequences of dysfunctional team member behavior. It seems self-evident that the interpersonal characteristics

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^{*} Corresponding author. Tel.: +1-212-216-5384; fax: +1-201-216-5385.

of team members will play a major role in the success of any team. Demographic variables (e.g. age, race, gender, seniority), abilities and personality variables are examples of team member interpersonal characteristics that should be related to effective or ineffective team behavior. This should be especially true of personality variables, which are a "mixture of values, temperament, coping strategies, traits, character and motivation" (Guion, 1998, p. 134). Personality variables seek to describe and predict the typical behavior of individuals. Thus, the level and mix of personality on a team should be an important factor in new product development (NPD) success.

What are the personality characteristics that make a NPD team successful? Surprisingly, little is known, although most models of team performance include team member behaviors as a key element (Hackman, 1983; Sundstrom et al., 1990; Stevens and Campion, 1994; Reilly and McGourty, 1998). For example, behavioral factors such as "cohesiveness" (Keller, 1986), have been cited as contributing to successful product development performance as well as performance in other work teams. Other important team-related behaviors include communication, decision-making, collaboration and leadership (Dominick et al., 1997; Reilly and McGourty, 1998).

While most research has focused on behavior internal to the team, other research has focused on the relationship between the team and the external environment. The importance of personality variables is implicit in these relationships. For example, research by Ancona and Caldwell (1992, 1990) looked at the importance of interactions between the NPD team and outsiders. Based on a factor analysis of a number of specific activities they defined four clusters: ambassador, task coordinator, scout and guard. Positive relationships were found between ambassadorial activities (activities related to protecting the team from outsiders and persuading outsiders to obtain resources) and performance and between task coordinator activities (obtaining feedback and negotiating and coordinating with outsiders) and performance.

The intent of this paper is to present a series of theoretical but testable research propositions on the relationship between personality variables and NPD team performance. Whetten (1989) notes that theoretical contributions should specify the contextual and temporal factors that set the boundaries of generalizability. Our operating assumptions are that the teams are reasonably stable and permanent and have as their objective the development of a new product or service. Our focus is on the team members and not the team leader or project manager. Before stating our research propositions we first review literature on personality and team performance, including the few studies that focus on NPD teams. Second, we suggest a series of testable research propositions for personality and performance in two types of NPD teams: those concerned with radical innovation and those concerned with incremental innovation.

2. Research on personality and team performance

Until fairly recently the use of personality measures to predict organizational performance was limited and unsystematic. From the 1960 and into the 1980s the research on personality and work-related performance was limited for two reasons. First, there was no persuasive evidence that personality factors were predictive of job performance. Secondly, there was no clearly agreed upon taxonomy of personality, which made it difficult to draw genera-

lizable conclusions about personality (Barrick and Mount, 1991). Indeed, one of the most widely used models of personality—Catell's 16 factors—could not be replicated by other researchers (Fiske, 1949; Tupes and Christal, 1961). The identification of the five-factor model (FFM) of personality (e.g. Tupes and Christal, 1961; Norman, 1963; Digman, 1990; Goldberg, 1992) has brought order to a somewhat disorganized field and, more importantly, has allowed research to be conducted and evaluated in a more consistent manner. This recent emergence of the FFM as a robust taxonomy of personality provides a common framework from which to examine personality and investigate how personality variables are related to both individual and team performance (Barrick and Mount, 1991; Costa and McCrae, 1988).

Meta-analytic research (Barrick and Mount, 1991; Tett et al., 1991) suggests that personality traits, as measured by the FFM, have considerable utility for predicting how people behave and perform in the workplace. Of particular interest is evidence (Tett et al., 1994; Day and Silverman, 1989; Barrick and Mount, 1991) that specific personality traits are related in predictable ways to performance in certain kinds of jobs. For example, extraversion is important for jobs in which interpersonal interactions play a significant role and openness is important for jobs in which learning plays a significant role (Barrick and Mount, 1991). Reviews by Jackson (1992), and Moreland and Levine (1992) conclude that personality variables are predictive of team performance. However, most of the studies included in the meta-analytic research focused on the relationship between FFM constructs and individual performance, not team performance.

2.1. The five-factor model and relevant measures

The FFM posits the following personality traits as a general explanatory framework for interpersonal behavior:

- *Openness:* The extent to which team members are imaginative, sensitive, intellectual, polished versus down to earth, insensitive, narrow, crude, simple.
- Stability: The extent to which team members are calm, enthusiastic, poised, and secure, versus depressed, angry, emotional, and insecure.
- *Agreeableness:* The extent to which team members are good-natured, gentle, cooperative, forgiving, hopeful versus irritable, ruthless, suspicious, uncooperative, inflexible.
- *Conscientiousness:* The extent to which team members are careful, thorough, achievement-oriented, responsible, organized, self-disciplined, scrupulous versus irresponsible, disorganized, undisciplined, unscrupulous.
- *Extraversion–introversion:* The extent to which team members are sociable, talkative, assertive, active versus retiring, sober, reserved, cautious.

Perhaps the best-known commercially available measure of the five factors is the NEO (Costa and McCrae, 1992). The NEO has two forms: a shorter (60 item) inventory called the NEO-FFI; and, a longer (240 item) inventory, the NEO PI-R. The Hogan personality inventory (1986) is a 206-item inventory that measures the five factors but breaks extraversion into two scores (surgency and sociability). Goldberg's 50-item adjective checklist (Goldberg, 1992) is one example of a number of public domain measures that are part of the International Personality Item Pool project at the Oregon Research Institute (Goldberg, 1999).

2.2. Relevant findings on personality and team performance

The limited research suggests that while team member personality is related to team performance and other variables important for the success of teams, different FFM variables predict performance in different types of teams. In the next section we summarize the existing research on FFM personality variables and team performance.

2.2.1. Openness

Openness should be related to the success of teams involved in creative tasks, or tasks performed under conditions of high uncertainty, such as radical innovation. Openness may be less important for group performance on a routine mechanical or a social task than for a problem-solving task (e.g. Driskell et al., 1987; Gibb, 1969; Cattell and Stice, 1954), or may even have negative relationships with performance with highly structured tasks. Some direct support is offered by Bouchard (1969), who notes that openness predicted group performance on a creative task. Barry and Stewart (1997) found a significant relationship between openness and "open communication" within simulated self-managed teams, but a significant negative relationship with "task focus". Crutchfield (1955), who found intellectual competence to be negatively correlated with conformity, provides indirect support.

In sum, the limited evidence supports the importance of openness for creative and imaginative tasks but suggests that openness is less important, or even detrimental, when the task is of a more routine nature.

2.2.2. Stability

Emotional stability should predict performance in team tasks regardless of the type of team (Driskell et al., 1987). Teams with a higher aggregate level of emotional stability should contribute to a relaxed atmosphere and promote team cooperation. On the other hand, "unstable teams" are more likely to engage in disruptive behaviors, lose focus and have difficulty in cooperating (e.g. Watson and Tellegen, 1985). For teams that work on tasks over a long period of time, emotional stability can contribute to team viability (e.g. their capability of working effectively together over time, as rated by observers). For example, Haythorn (1953), Hough (1992), and Barrick et al. (1998) found that emotional stability was positively related to the team's viability. Barrick et al. also found a positive relationship between emotional stability and performance.

Thoms et al. (1996) found a significant relationship between emotional stability and perceived self-efficacy for performing in self-managed teams. Mann (1959), and Heslin (1964) both found emotional stability to be one of the best predictors of team performance. Haythorn (1953) found that emotional stability was related to team effectiveness and orientation towards job completion. Greer (1955) reported that "nervousness tendencies" (i.e. instability) in army team members were negatively related to team effectiveness. Finally, the findings of Hough (1992) provide evidence that emotional stability is positively related to teamwork.

In sum, the evidence suggests that the team level of emotional stability should be positively related to team performance for a wide range of team tasks.

2.2.3. Agreeableness

For team tasks that require interpersonal interaction, social competence and interpersonal tact, agreeableness is an important trait. One of the facets of agreeableness is the propensity for cooperative behavior. Since cooperation has been shown to be important for the long-term success of teams (Hackman, 1990) it is reasonable to expect that higher levels of team agreeableness will be associated with team success. Evidence for the relationship between agreeableness and team performance is provided by Hough (1992), Barrick et al. (1998), and Stevens et al. (1999). A more recent study by Neuman and Wright (1999) found agreeableness (as measured by the lowest scoring team member) to be a significant predictor of effectiveness of human resources teams. Thoms et al. (1996) reported a significant relationship between agreeableness and perceived self-efficacy for working in self-managed teams.

For some other types of teams agreeableness may be unimportant or even negatively related to performance. McCrae and Costa (1989) suggest that agreeableness should be associated with team cohesiveness, which under some conditions might lead to successful performance. On the other hand, high cohesiveness can also lead to "groupthink". According to Janis (1972) when teams are highly cohesive they are susceptible to "groupthink". Groupthink occurs when team members shut themselves off from the environment or from others that may have different views, they develop an unrealistic sense of righteousness and may refuse to change their decision despite being confronted with conflicting information. Janis points out that these behaviors impede a team's effectiveness on problem solving tasks.

Haythorn (1953) found no significant relationship between group member sociometric rating (a measure of agreeableness) and group productivity. Weick and Penner (1969) found that team performance is inversely related to the extent to which team members like one another. Less direct evidence is provided by Guzzo and Waters (1982) who found that groups produced the highest quality task decision when they suppressed behaviors that might be related to agreeableness during task performance.

The evidence suggests that agreeableness may be important for performance in some teams, especially long-term teams with tasks that involve persuasion, or other socially-related dimensions. When tasks do not require a high degree of social interaction, the evidence suggests that agreeableness may actually inhibit performance in teams.

2.2.4. Conscientiousness

Of the FFM constructs, conscientiousness has been found to have the strongest and most reliable correlation with individual performance across job settings (Barrick and Mount, 1991; Mount and Barrick, 1995). Keller (1997) suggests that the achievement-striving facet of conscientiousness, because it taps an emphasis on high career investment and devotion to work, should be predictive of R&D performance in general for scientists and engineers. Hough's (1992) meta-analysis found conscientiousness to be related to teamwork. Barrick et al. (1998) reported a significant relationship between conscientiousness and team performance. Neuman and Wright (1999) found conscientiousness (as measured by the lowest scoring team member) to be a significant predictor of supervisor ratings and task accuracy for human resources teams.

Zander and Forward (1968) found that team members, who score high on achievement motivation (a component of conscientiousness), show a greater concern for the successes of the team. Thoms et al. (1996) found that higher levels of conscientiousness were correlated

with higher self-efficacy for working in teams. Schneidner and Delaney (1972) found that teams composed of members with higher achievement motivation scores solved complex problems more efficiently. Given this evidence it seems reasonable to assume that higher levels of conscientiousness should result in better team performance.

The research evidence suggests that conscientiousness should be positively related to team performance across a wide variety of tasks and settings.

2.2.5. Extraversion

In a team setting the higher scores on extraversion should be related to higher levels of social activity (Barrick and Mount, 1991). Bouchard (1969) found that extraversion was consistently related to performance on group creative and problem solving tasks. Greer (1955) found a positive relationship between social activeness (an indicator of extraversion) and group effectiveness. Barrick et al. (1998) found a positive relationship between extraversion and the viability of the team (as judged by supervisors). On the other hand, some tasks may tend to be disrupted by high levels of interaction; for example, tasks involving logic and precision. Gurnee (1937) found a positive relationship between group members' scores on extraversion and the number of errors that groups made as they collectively moved through an electric-contact maze. Barry and Stewart (1997) found a negative relationship between extraversion and task focus. Driskell et al. (1987) predict a negative relationship between extraversion and performance for such tasks.

The research suggests that extraversion should be related to team performance when tasks involve imaginative or creative activity but may inhibit performance when tasks call for precise, sequential and logical behavior.

3. Heterogeneity and team performance

Thus, far, we have examined the research on the average level of each of the FFM factors on team performance. A different question may be posed, however. Is it better to have a team whose members are all very similar (homogeneous) or a team whose members are very dissimilar (heterogeneous)? For any specific variable, heterogeneity can be measured by the within group standard deviation on the variable. For a set of variables, multivariate distance measures (e.g. Euclidean distance measures) can be used as a measure of heterogeneity. Although there is only very limited evidence on the role of heterogeneity of personality on team performance, there is evidence that diversity on other variables impacts team performance.

Guzzo and Dickson (1996) cite several research studies that indicate positive relationships between team heterogeneity and creativity and decision-making effectiveness. They note, "there is evidence that team effectiveness is well-served by diverse members when teams perform cognitive, creativity-demanding tasks". Whitney and Smith (1983) showed that role heterogeneity was associated with greater openness to new information and more effective use of new information. Maznevski (1994) reviewed literature that examined the effects of diversity on performance of decision-making teams. Maznevski suggested that diversity in membership might be desirable for increasing the quantity of solutions offered and the quantity of alternatives offered.

A narrow range of viewpoints among team members might interfere with team performance on decision-making tasks. When most team members share the same point of view, further discussion of alternatives may be limited. Alternatively, when most of the team members hold the same point of view, they may pressure team members with opposing points of view to conform instead of discussing the opposing point of view openly. As a result, the team decision might not undergo critical evaluation and modification.

Research by Schwartz et al. (1976) illustrates this point. They studied the effects of different management styles: either task-oriented or relationship-oriented. They found that heterogeneous teams demonstrated greater variability of responses in solving business problems than homogeneous teams. Ziller (1955) notes that it is more likely that the most superior decision will be included in a relatively heterogeneous range of alternatives than in a relatively homogeneous range of alternatives.

Positive effects of heterogeneity in background and expertise have been found for other situations. For example, Magjuka and Baldwin (1991) found heterogeneity to be positively related to the long-term success of teams working on employee involvement programs. Bantel and Jackson (1989) found that organizational innovations were positively related to heterogeneity in functional expertise among members of top management teams in the banking industry. Watson et al. (1993) found some initial differences in favor of homogeneous teams but as time increased heterogeneity became positively related to selected aspects of task performance. In particular, more heterogeneous teams were better at generating alternative solutions and applying a range of perspectives in analyzing business cases.

Jackson et al. (1995) attempted to summarize empirical evidence from a number of related disciplines about the link between within team heterogeneity and team effectiveness. They note that within-team heterogeneity is positively related to creativity and the decision-making effectiveness of teams. They refer to heterogeneity in a broad sense and include a mix of personalities in addition to other variables (gender, attitudes, background and experiences). Evidence supporting the importance of member heterogeneity on team performance seems to be the clearest in the domain of creative and intellective tasks. Radical innovation tasks as described later are part of this domain. One other potential advantage of heterogeneity is the prevention of groupthink. Heterogeneous teams should produce a greater diversity of opinions and views and thus be less susceptible to groupthink.

In some cases, heterogeneity may not be desirable. For example, Barrick et al. (1998) found a significant negative relationship between the variance of conscientiousness and team performance. Homogeneous teams have been characterized as having less conflict, more effective communication, and more cohesiveness. These characteristics can enhance team performance in certain situations. Because heterogeneity leads to greater conflict, Triandis et al. (1965) suggested that heterogeneous teams are more likely to experience interpersonal stress. In teams composed of heterogeneous religious and socio-cultural members (Fiedler et al., 1961) members experienced increased social strain. Haythorn et al. (1956) found that teams that were heterogeneous with respect to the California F scale (a measure of authoritarianism) had a greater degree of conflict than more homogeneous teams. Thus, heterogeneity appears to exact a price in more interpersonal conflict and poorer communication between members.

Campion et al. (1993) found heterogeneity of team members' background and expertise to be unrelated or negatively related to effectiveness for clerical teams in a large financial

services company. Heterogeneity was negatively correlated with measures of productivity but was uncorrelated with managers' judgments of team performance or with employee satisfaction. Another study by Jackson et al. (1991) found membership in heterogeneous teams to be associated with higher turnover.

In sum, the research suggests that heterogeneous teams should produce higher quality decisions and generate more creative ideas than homogeneous teams. Homogeneous teams should be more cohesive, have less conflict and turnover and perform well when decision making and new ideas are less important.

4. Heterogeneity of personality and team performance

In their review of team performance, Guzzo and Dickson (1996) posit several "open questions" for research. One of the questions is how does diversity (or heterogeneity) affect team performance? The few studies of heterogeneity of personality when combined with studies of heterogeneity on other variables lead to the general conclusion that heterogeneous teams should outperform homogeneous teams as the task becomes less structured. For more structured tasks, homogeneous teams may be better.

A few studies have examined the relationship between heterogeneity of personality and team performance. Hoffman (1959) found that heterogeneous groups were superior in problem solving to homogeneous groups. In addition, heterogeneous groups produced more inventive solutions. In a related study, Hoffman and Maier (1961) found that heterogeneous groups produced a greater proportion of high quality solutions than homogeneous groups. Hoffman and Maier (1961) suggest that the conflict resulting from heterogeneous team members' opposing viewpoints may have caused more complete solutions to emerge or new solutions to be invented.

Altman and Haythorn (1967) found that heterogeneous groups outperformed homogeneous groups on decision-making and on an analytical task. One exception concerned "need for affiliation", where homogeneous groups performed best. Aamodt and Kimbrough (1982) examined the impact of personality composition on group problem solving. Homogeneous and heterogeneous groups with respect to personality were required to work together and to agree on the best solution to two human relations problems. Aamodt and Kimbrough (1982) found a significant difference in the quality of the group decision in favor of heterogeneous groups. Tuckman (1967) found that heterogeneous groups exhibit superior performance in relation to homogeneous groups when a problem solving task was less structured. With a highly structured task, however, homogeneous groups outperformed heterogeneous groups.

In sum, the limited research evidence suggests that heterogeneous teams should perform better in less structured product developments, for example, when market uncertainty and technological uncertainty are high, as in radical innovation. Homogeneous teams should perform better as the task becomes more structured.

5. Types of product development teams

Increased competition, change, and uncertainty characterize virtually all industries in today's turbulent business environment. Long-term prosperity can only be achieved

through constant pursuit of product innovation (Lynn and Akgun, 1998). Research and development can be viewed from a multidimensional framework. As an example, innovation can be viewed as competency enhancing versus competency destroying (Tushman and Anderson, 1986). Competency enhancing innovations are those that fit with the firm's existing capabilities, whereas competency destroying innovations are those that challenge the firms existing capabilities.

On the other hand, Barczak and Wilemon (1989) identify two major types of teams responsible for new product development: operating and innovating. Operating teams are concerned with maintaining competitive positions in existing businesses and, as a result, they usually focus on incremental innovation or small improvements to current products. Characteristics of these groups include operating in relatively stable environments, being rule and planning-oriented, and emphasizing current products. Innovating teams, in contrast, focus on developing a new business for the firm. They are more likely to focus on important new products for unfamiliar markets. These types of teams produce radical innovations. Radical innovation teams are usually separated from the daily activities of the firm. Characteristics of innovating groups include operating in a dynamic environment, emphasizing initiative and risk taking and maintaining loose methods of control. These product development teams must choose an innovation strategy that is tailored to the degree of market and technology uncertainty (Ansoff, 1965, 1988; Moriarty and Kosnik, 1990). Lynn and Akgun (1998) have further differentiated NPD teams into four types; incremental, radical, evolutionary technology and evolutionary marketing. For purposes of the present paper we will focus on the role of personality in the two most extreme and differentiated: incremental and radical.

Incremental innovation exists under highly certain environments, when a currently served market with mature technologies is targeted. Incremental innovations may include product changes or improvements, product line extensions, and "me too" products that are similar to the competition. A good example of incremental innovation is the double stuff Oreo cookie by Nabisco. Under such conditions the appropriate innovation strategy focuses on being market-based and process-based. The customers are well defined and are typically well known, as is the technology required to produce the innovation. This type of innovation usually encounters fewer surprises than the more radical type.

Radical innovation, in contrast, exists when both market and technology uncertainties are high. Innovations of this type pose severe challenges for new product teams because the market is not well understood and the product is still evolving and changing with the market. These types of innovations require a focus on a learning-based strategy because experimenting is an essential component of the process. Product teams may try a product in the market to learn, improve it, and try it again (Lynn et al., 1996). For example, the early VCR models were too expensive and limited and consequently, they failed in the marketplace. However, manufacturers continued to interact with users, learned from them, and accordingly improved the technical performance of the VCR, reduced its price, and successfully reintroduced the product to the market (Rosenbloom and Cusumano, 1987). Incremental and radical innovation teams, described previously, fall into these two main types of groups. Although we recognize that there are other possible categorization teams, our research propositions will focus on these two major types of NPD teams.

6. Personality and product development teams

Research on team member personality has provided some interesting insights, but has left some unanswered questions as to how personality is related to team performance and whether different personality variables are more important for different types of teams (Morgan and Lassiter, 1992; Oser et al., 1989; Driskell and Salas, 1992; Hogan and Hogan, 1989; Durham et al., 1997; Mann, 1959; Burchfield, 1997; Schutz, 1955; Altman and Haythorn, 1967). While these studies have shown significant relationships for some variables, the results are difficult to interpret and apply to NPD teams for two reasons. The first reason has to do with the inconsistency of the personality framework used in the different research. With some exceptions (i.e. Burchfield, 1997) the research is marked by inconsistent constructs used to define personality. A second problem with the past research is that many of the studies have been done with simulated teams and short-range tasks or projects, sometimes consisting of tasks less than an hour's length. As an example, a number of studies have investigated the relationship between team member personality and creativity as the team outcome (e.g. Bouchard, 1969; DeBiasio, 1986; George, 1990; Strube et al., 1989). All of these studies were done in laboratory settings.

Only two studies were found that directly examined the role of personality in NPD performance. One study examined relationships between the personality of an "analyst", who evaluates product ideas at the fuzzy front end—the period between when the opportunity for NPD is known and when a serious effort is mounted on the development project (Smith and Reinertsen, 1997). Stevens et al. (1998) found significant differences between the number of decisions and the degree of success for different personality type. Although this research does not directly bear on the issue of team performance it provides evidence for the impact of personal style on new product development. A second study (Kichuk and Wiesner, 1997), done with simulated NPD teams, found significant differences between successful and unsuccessful teams for average scores on extraversion, agreeableness, and neuroticism. Driskell et al. (1987), Bouchard (1972), DeBiasio (1986), and Tuckman (1967) suggest that different personality styles are required depending upon the team's task. Because NPD teams differ with respect to typical tasks, it is important to consider the role of personality for different types of NPD teams.

7. Research propositions

7.1. Research propositions related to the level of the FFM in product development teams

It is now possible to propose relationships between personality and performance in these two major types of NPD teams. Because we are dealing with teams, the role of personality within a team can take two different forms. First, the average *level* of a particular personality variable within the team may be related to team performance. Second, the degree of *heterogeneity* of a particular trait may play a role in team performance. As already noted, the average level of a personality trait is usually indicated by the mean of a variable. For a single variable, the variance or standard deviation would be an indicator of the degree of heterogeneity of the team. For multiple variables a variety of distance measures such

Table 1

Proposed relationships be incremental and radical in	tween the average level of team personality novation teams	y variables and overall performance in
Personality variable	Incremental	Radical

Personality variable	Incremental	Radical	
Openness	Zero	Positive	
Stability	Positive	Zero	
Agreeableness	Zero	Positive	
Conscientiousness	Positive	Positive	
Extraversion	Positive	Positive	

as Euclidian, squared Euclidian or city block metrics could be used to characterize the heterogeneity of a team.

Although our research propositions are stated for two categories of teams, incremental and radical, it is important to recognize that the variables that distinguish between the two teams are continuous. Thus, a proposition that suggests a zero correlation between a variable and success does not necessarily imply that a variable is completely unimportant, but rather that it is unlikely to distinguish successful from unsuccessful teams. As an example, a threshold level of creativity may be important for incremental NPD teams but may not differentiate success from failure. On the other hand, the level of creativity beyond the threshold level, might have a significant relationship with success in radical innovation teams.

Table 1 summarizes our research propositions for the level of each FFM variable for incremental and radical innovation teams.

According to Costa and McCrae (1992) individuals who are high on openness possess traits such as broad-mindedness, a willingness to consider new and unconventional ideas and higher levels of curiosity. As we have already noted, the research indicates that openness becomes more important as tasks become more creative in nature. It follows that the level of openness should predict performance in radical innovation. Radical innovation involves creative solutions to problems under conditions of high uncertainty. In contrast, incremental innovation involves less creative activity under more certain conditions. Incremental innovation teams work within a well-established framework where both the technology and the market are known. It is reasonable to assume that since incremental innovation team tasks do not typically require creativity or solving abstract problems, openness will not be related to the overall performance in incremental innovation teams.

Proposition 1. The average level of openness will be positively related to overall performance in radical innovation teams, but will not be related to performance in incremental innovation teams.

Previously cited research (Haythorn, 1953; Mann, 1959; Shaw, 1981; Hough, 1992; Watson and Tellegen, 1985) provides evidence for the positive role of emotional stability on team performance. We propose that FFM emotional stability will be especially important for the performance of incremental NPD teams. Incremental innovation includes focused activities that place a premium on coordinated tasks. Unstable individuals can disrupt team cohesiveness and coordination. On the other hand, radical innovation demands less coordi-

nated behavior. In fact, an argument could be made that an overemphasis on coordination might inhibit the development of breakthrough ideas. We propose that emotional stability will be less important for radical innovation teams.

Proposition 2. The average level of emotional stability will be positively related to overall performance in incremental innovation teams but will not be related to performance in radical innovation teams.

The research on agreeableness and team performance is mixed. Agreeableness appears to be more important when tasks are social or interpersonal in nature or when the team must function for a longer period of time. In contrast, a high level of team agreeableness may inhibit tasks that are more routine and highly task dependent. We propose a positive relationship between agreeableness and performance in radical innovation teams since more social interaction may be necessary due to the uncertainty of the task. In addition, radical innovation tends to take longer so teams must function together for longer time periods—a condition that makes agreeableness an important trait. On the other hand, a high level of agreeableness may not have much importance for incremental innovation teams, where the task is highly certain and routine.

Proposition 3. The average team level of agreeableness will be positively related to overall performance in radical innovation teams but unrelated to the overall performance in incremental innovation teams.

As already noted, conscientiousness is related to performance across a wide variety of jobs and tasks. It should be noted that conscientiousness has two major facets, or aspects. One facet has to do with the motivation to achieve. The second facet has to do with reliability, sticking to schedules and plans. The average level of conscientiousness of a team should be related to performance for both radical and incremental teams. Reliability should be highly related to performance in incremental innovation where sticking to a certain schedule with specific deliverables is important. On the other hand, achievement motivation should be important for radical innovation where setting high goals and working harder may result in the development of a breakthrough product. We propose that the level of conscientiousness should be related to performance for both radical and incremental innovation.

Proposition 4. The average level of conscientiousness will be positively related to overall performance in both incremental and radical innovation teams.

Although some research has shown a negative relationship between extraversion and task focus, most research suggests that extraversion is important for teamwork in general because of the importance of affiliative behaviors in team settings. Higher levels of extraversion have been found to predict performance in several different types of teams and have also been related to team viability. In addition, extraversion may play an important role in establishing and maintaining effective relationships with individuals and groups outside the team. For both radical and incremental innovation teams, the level of extraversion should be associated with better performance.

mance in incremental and radical innovation teams				
Personality variable	Incremental	Radical		
Openness	Positive	Negative		
Stability	Negative	Unrelated		
Agreeableness	Negative	Positive		
Conscientiousness	Negative	Positive		
Extraversion	Unrelated	Positive		
Overall	Negative	Positive		

Table 2
Proposed relationships between the heterogeneity of team members on personality variables and overall performance in incremental and radical innovation teams

Proposition 5. The average level of extraversion will be positively related to overall performance in both incremental innovation teams and radical innovation teams.

7.2. Research propositions related to the heterogeneity of FFM personality variables in product development teams

A second set of propositions related to the heterogeneity of personality is summarized in Table 2. For individual personality factors, heterogeneity could be defined as the standard deviation of a variable (e.g. conscientiousness) within a team. An alternative definition of heterogeneity is the overall similarity of each of the members to one another across all of the FFM variables. Overall similarity could be defined by the average correlation between team members personality profiles, or some measure of average distance on the variables (e.g. squared Euclidian distance). We suggest research propositions for each of the FFM factors and then for the overall heterogeneity of the team.

Although the average level of openness for incremental innovation teams may be less important, it is proposed that some team members should be high on openness. Although incremental innovation teams work under conditions of certainty the team may still be confronted with surprises and need some creativity and openness to new ideas or methods. Thus, the more heterogeneous the team is on this factor, the better the team performance should be. In contrast, it is important for all radical innovation team members to be high on openness. Thus, we propose that radical innovation teams that are consistently high in openness (i.e. homogeneous) will be more successful.

Proposition 6. Heterogeneity of openness will be positively related to performance in incremental innovation teams, but negatively related to performance in radical innovation teams.

Several researchers have pointed out that emotional stability is positively related to team effectiveness (Haythorn, 1953; Mann, 1959; Shaw, 1981). Unstable people are moody and unpredictable, and tend to disrupt team coordination regardless of the nature of the task. Heterogeneity in stability can be a detriment in the performance of incremental innovation teams in which a highly focused and structured series of steps need to be performed and the need for mutually coordinated behavior is high. Therefore, heterogeneity of team members

on emotional stability should be negatively related to performance in incremental innovation teams. As noted earlier, we assume that emotional stability is unrelated to performance on radical innovation teams. Similarly, we assume that the heterogeneity of stability will be unrelated to performance in radical innovation.

Proposition 7. Heterogeneity of team members on emotional stability should be negatively related to overall performance in incremental innovation teams but unrelated to performance in radical innovation teams.

Members of homogeneous teams spend more time promoting the personal relations of their team members than members of heterogeneous teams (Hoffman and Smith, 1960). It is assumed that interpersonal relations are better for homogeneous teams than heterogeneous teams. Agreeable people exhibit traits such as compliance and prefer to cooperate than to compete. For example, high scorers on this trait tend to defer to others, inhibit aggression and to forgive and forget (Costa and McCrae, 1992). In contrast, low scorers prefer to compete rather than to cooperate. Agreeableness of all team members may be more influential on performance if the task is more focused and requires cooperation such as performance in incremental innovation teams. However, radical innovation teams operate in dynamic environments and maintain loose methods of control (Barczak and Wilemon, 1989). It is reasonable to assume that, in order to maintain loose methods of control, radical innovation teams should include agreeable members, as well as some members who are less agreeable and will challenge existing ideas and methods.

Proposition 8. The heterogeneity of team members on agreeableness should be positively related to overall performance in radical innovation teams but negatively related to overall performance in incremental innovation teams.

Conscientious individuals have the tendency to think carefully before acting, and perform best under focused and structured tasks. Driskell et al. (1987) point out that prudent, conscientious people are conforming and should perform well on tasks that require systematic or rule-guided performance. We propose that for incremental innovation all team members should be relatively conscientious. Thus, heterogeneity should have a negative effect on performance. As pointed out earlier, the average level of team members on conscientiousness might be less influential on performance if the tasks are more abstract and require creativity such as the tasks required of radical innovation teams. However, including one or two members who think carefully, and who are rule-guided, should improve overall performance on radical innovation teams. Thus, we propose that for radical innovation, heterogeneity with respect to conscientiousness should improve performance.

Proposition 9. The heterogeneity of team members on conscientiousness should be positively related to overall performance in radical innovation teams but negatively related to overall performance in incremental innovation teams.

Extraversion includes several facets that we assume to be related to NPD success. For example, the facets friendliness, gregariousness and assertiveness (Costa and McCrae, 1992)

may be important for some team members, especially in radical NPD teams. Such characteristics could be critical for external interfaces between the team and the organization (Ancona and Caldwell, 1990, 1992). The same traits are also related to leadership roles within the team. On the other hand, some diversity in the level of these characteristics is probably desirable for radical NPD teams since not all members need to play this role.

An additional facet, excitement seeking (Costa and McCrae, 1992) may also play a role in radical innovation. This facet has been related to risk-taking behavior (Ashton, 1998) and novelty seeking (Cloninger et al., 1996). Since radical NPD teams tend to operate in a dynamic environment, emphasizing initiative and risk taking it is assumed that at least some members of the team should be high in extraversion. On the other hand, it seems reasonable that an effective team should also have some members less prone to risk-taking. In sum, we conclude that radical NPD teams that are heterogeneous with respect to extraversion will be more successful.

On the other hand, the higher certainty of incremental NPD should lower demands for role differentiation related to risk-taking and external interfaces. The opportunity for risk taking will be lower in incremental NPD teams and external interfaces should be less critical. We conclude that for incremental NPD teams, heterogeneity on extraversion should be less important.

Proposition 10. The heterogeneity of team members on extraversion should be positively related to overall performance in radical innovation teams but unrelated to overall performance in incremental innovation teams.

Research on team heterogeneity appears to support the proposition that heterogeneous teams will perform better when tasks are more abstract and involve creative solutions. Thus, we propose that teams that have heterogeneous personality structures will perform better when the objective is radical innovation. On the other hand, research also suggests that homogeneous teams will perform better on tasks that involve more routine tasks. We propose that teams that are more homogeneous will perform better in incremental innovation teams.

Proposition 11. The overall heterogeneity of team members on FFM personality variables will be positively related to overall performance in radical innovation teams and negatively related to overall performance in incremental innovation teams.

8. Conclusions and potential implications

Our review of the literature suggests that the level and heterogeneity of personality factors have a potentially important role in the effectiveness of NPD teams. As we have pointed out, research directly linking personality to team performance is sparse and our propositions are accordingly tentative. However, the research propositions articulated in this paper have implications for research, theory and practice relevant to NPD team effectiveness.

The present paper had two major objectives. The first was to summarize and highlight the existing research on personality and team performance using the five-factor model as a framework. Some tentative conclusions can be reached, based on this review. One conclusion is that the personality of team members is related to the success of the team. For example, higher agreeableness and higher conscientiousness appear to be associated with more effective team performance in general. In addition, higher levels of openness appear to be related to better performance when the task involves creativity. Research on the other factors, emotional stability and extraversion, provide a less clear picture. Although research on heterogeneity is even more limited, evidence from research on other variables suggests that heterogeneity of personality variables may have a significant impact on team performance.

Our research propositions have also suggested how the level and heterogeneity of the five-factors might be related to performance in two different types of NPD teams. We suggest that radical NPD, which tends to be less certain, less structured, more dynamic and calls more on creativity should have teams that have relatively high levels of agreeableness, conscientiousness, openness and extraversion. Radical teams should also perform better when the personalities of the members are more heterogeneous with respect to agreeableness, conscientiousness and extraversion. openness should be relatively high for all radical NPD team members and we propose that heterogeneity of team members on stability should be unrelated to success in radical NPD. For incremental NPD teams where the task is more certain and structured we suggest that the most important personality variables are stability and conscientiousness. Our review also suggests that homogeneous teams will perform better in incremental NPD teams with the exception of openness, where we suggest that heterogeneity might be more advantageous. It is hoped that our research propositions and the framework of the five-factor model will stimulate additional and needed research in this area.

Theoretical models of the role of personality on team performance are generally lacking. The present review provides some insight into how team performance might be impacted by the personalities of its members and also suggests that personality may interact with the situational demands of the team task. Studies of NPD teams offer a potentially fertile ground for developing theories of team behavior and the role that personality can play. Because NPD teams vary with respect to the degree of structure and task uncertainty research on NPD teams can help elucidate the relationship between personality and the mediating variables that are related to success. We have only suggested a few mediating variables but further research can help in constructing a theory of the role that personality and aspects of team behavior (e.g. cohesion, collaboration) play in success of different types of teams.

A final set of implications are practical in nature. Assuming solid evidence exists on the optimal personality profile of different types of NPD teams there are at least three types of implications for practice. First, personality variables could be used to select employees for work in the area of new product development. Minimal levels of openness, conscientiousness and agreeableness, for example, might be established as selection criteria for employees working on radical innovation. This application is a relatively straightforward use of personality as a selection tool. A second type of application is the assignment of existing employees to NPD teams based on personality variables. Assuming additional research supports some of the propositions suggested here, employees could be assigned to provide an optimal mix of personality variables depending upon the type of NPD. A third application is more developmental in nature. An understanding of the personality characteristics of employees assigned to NPD teams should allow better developmental planning, coaching and management of NPD team members. For example, a highly agreeable individual might

be counseled to use this strength to play a supportive role in mediating team conflict; or to recognize situations where challenging the status quo is beneficial even though it may be contrary to a highly agreeable individual.

References

- Aamodt, M.G., Kimbrough, W.W., 1982. Effect of group heterogeneity on quality of task solutions. Psychological Reports 50, 171–174.
- Altman, I., Haythorn, W.W., 1967. The effects of social isolation and group composition on performance. Human Relations 20, 313–340.
- Ancona, D.G., Caldwell, D.F., 1990. Improving the performance of new product teams. Research Technology Management 33 (2), 25–29.
- Ancona, D.G., Caldwell, D.F., 1992. Bridging the boundary: external activity and performance in organizational teams. Administrative Science Quarterly 37 (4), 634–665.
- Ansoff, H.I., 1965. Corporate Strategy. McGraw-Hill, New York.
- Ansoff, H.I., 1988. The New Corporate Strategy. Wiley, New York.
- Ashton, M.C., 1998. Personality and job performance: the importance of narrow traits. Journal of Organizational Behavior 19, 289–303.
- Bantel, K.A., Jackson, S.E., 1989. Top management and innovations in banking: does composition of the top teams make a difference? Strategic Management Journal 10, 107–124 (special issue).
- Barczak, G., Wilemon, D., 1989. Leadership differences in new product development teams. Journal of Product Innovation Management 6, 259–267.
- Barrick, M.R., Mount, M.K., 1991. The big five personality dimensions and job performance: a meta-analysis. Personnel Psychology 44, 1–26.
- Barrick, M.R., Stewart, G.L., Neubert, M.J., Mount, M.K., 1998. Relating member ability and personality to work-team processes and team effectiveness. Journal of Applied Psychology 83 (3), 377–391.
- Barry, B., Stewart, G.L., 1997. Composition, process, and performance in self-managed groups: the role of personality. Journal of Applied Psychology 82 (1), 62–78.
- Bouchard Jr., T.J., 1969. Personality, problem solving procedure, and performance in small groups. Journal of Applied Psychology Monograph 53, 1–29.
- Bouchard Jr., T.J., 1972. Training, motivation, and personality as determinants of the effectiveness of brainstorming groups and individuals. Journal of Applied Psychology 56, 324–331.
- Burchfield, M., 1997. Personality composition as it relates to team performance, Doctoral Dissertation. Stevens Institute of Technology, Hoboken, NJ.
- Campion, M.A., Medsker, G.J., Higgs, A.C., 1993. Relations between work group characteristics and effectiveness: implications for designing effective work groups. Personnel Psychology 46, 823–850.
- Cattell, R.B., Stice, G.F., 1954. Four formulae for selecting leaders on the basis of personality. Human Relations 7, 493–507.
- Cloninger, C.R., Adolfsson, R., Srvakic, N.M., 1996. Mapping genes for human personality. Nature Genetics 12, 3–4.
- Costa, P.T., McCrae, R.R., 1988. Personality in adulthood: a 6-year longitudinal study of self-reports and spouse ratings on the NEO personality inventory. Journal of Personality and Social Psychology 54, 853–863.
- Costa Jr., P.T., McCrae, R.R., 1992. Revised NEO personality inventory (NEO-PI-R) and NEO five-factor inventory (NEO-FFI): Professional manual Odessa, FL: Psychological Assessment Resources.
- Crutchfield, R.S., 1955. Conformity and character. American Psychologist 10, 191-198.
- Day, D.V., Silverman, S.B., 1989. Personality and job performance: evidence of incremental validity. Personnel Psychology 42, 25–36.
- DeBiasio, A.R., 1986. Problem solving in triads composed of varying numbers of field-dependent and field-independent subjects. Journal of Personality and Social Psychology 51, 749–754.
- Digman, J.M., 1990. Personality structure: emergence of the five-factor model. In: Rosenzweig, M.R., Porter, L.W. (Eds.), Annual Review of Psychology. Annual Reviews, Palo Alto, CA, pp. 417–440.

- Dominick, P.G., Reilly, R.R., McGourty, J.W., 1997. The effect of peer feedback on team member behavior, group. Group and Organizational Management 22, 508–520.
- Driskell, J.E., Salas, E., 1992. Collective behavior and team performance. Human Factors 34, 277–288.
- Driskell, J.E., Salas, E., Hogan, R., 1987. Taxonomy for composing effective naval teams, Technical Report no. TR87002. Naval Training Systems Center, Orlando, FL.
- Durham, C.C., Knight, D., Locke, E.A., 1997. Effects of leader role, team-set goal difficulty, efficacy, and tactics on team effectiveness. Organizational Behavior and Human Decision Processes 72, 203–231.
- Fiedler, F.F., Meuwese, W., Oonk, S., 1961. An exploratory study of group creativity in laboratory tasks. Acta Psychologia 18, 100–119.
- Fiske, D.W., 1949. Consistency of the factorial structures of personality ratings from different sources. Journal of Abnormal and Social Psychology 44, 329–344.
- George, J.M., 1990. Personality, affect, and behavior in groups. Journal of Applied Psychology 75, 107–116.
- Gibb, C.A., 1969. Leadership. In: Lindzey, G., Aronson, E. (Eds.), Handbook of Social Psychology, Vol. 4. Addison-Wesley, New York.
- Goldberg, L.R., 1992. The development of markers of the big five-factor structure. Psychological Assessment 4, 26–42.
- Goldberg, L.R., 1999. A broad-bandwidth, public-domain, personality inventory measuring the lower-level facets of several five-factor models. In: Mervielde, I., Deary, I.J., De Fruyt, F., Ostendorf, F. (Eds.), Personality Psychology in Europe, Vol. 7. Tilburg University Press, Tilburg, The Netherlands, pp. 7–28.
- Greer, F.L., 1955. Small group effectiveness, Institute Report no. 6. Institute for Research on Human Relations, Philadelphia.
- Guion, R.M., 1998. Assessment, Measurement and Prediction for Personnel Decisions. Lawrence Earlbaum, Mahwah. NJ.
- Gurnee, H., 1937. Maze learning in the collective situation. Journal of Psychology 3, 437-443.
- Guzzo, R.A., Dickson, M.W., 1996. Teams in organizations: recent research on performance and effectiveness. Annual Review of Psychology. Annual Reviews, Palo Alto, CA.
- Guzzo, R.A., Waters, J.A., 1982. The expression of affect and the performance of decision-making groups. Journal of Applied Psychology 67, 67–74.
- Hackman, J.R., 1983. A normative model of work team effectiveness, Technical Report no. 2. Yale School of Organization and Management, New Haven, CT.
- Hackman, J.R., 1990. Conclusion: creating more effective work groups in organizations. In: Hackman, J.R. (Ed.), Groups that Work and Those that Don't. Jossey-Bass, San-Francicso.
- Haythorn, W., 1953. The influence of individual members on the characteristics of small groups. Journal of Abnormal and Social Psychology 48, 276–284.
- Haythorn, W., Couch, A., Haefner, D., Langham, P., Carter, L.F., 1956. The behavior of authoritarian and equalitarian personalities in groups. Human Relations 9, 57–74.
- Heslin, R., 1964. Predicting group task effectiveness from member characteristics. Psychological Bulletin 62, 248–256
- Hoffman, L.R., 1959. Homogeneity of member personality and its effect on group problem solving. Journal of Abnormal and Social Psychology 58, 22–32.
- Hoffman, L.R., Maier, N.R.F., 1961. Quality and acceptance of problem solving solutions by members of homogeneous and heterogeneous groups. Journal of Abnormal and Social Psychology 62, 401–407.
- Hoffman, L.R., Smith, C.G., 1960. Some factors effecting the behaviors of members of problem solving groups. Sociometry 23, 272–291.
- Hogan, J., Hogan, R., 1989. Noncognitive predictors of performance during explosive ordinance disposal training. Military Psychology 1, 117–133.
- Hough, L.M., 1992. The big five personality variables—construct confusion: description versus prediction. Human Performance 5, 139–155.
- Jackson, S.E., 1992. Team composition in organizational settings: issues in managing an increasingly diverse workforce. In: Worchel, S., Wood, W., Simpson, J. (Eds.), Group Process and Productivity. Sage, Newbury Park, CA, pp. 138–173.
- Jackson, S.E., Brett, J.F., Sessa, V.I., Cooper, D.M., Julin, J.A., Peyronnin, K., 1991. Some differences make a difference: individual dissimilarity and group heterogeneity as correlates of recruitment, promotion and turnover, promotion and turnover. Journal of Applied Psychology 76, 675–689.

- Jackson, S.E., May, K.L., Whitney, K., 1995. Understanding the dynamics of diversity in decision-making teams. In: Guzzo, R.A., Salas, E. (Eds.), Team Effectiveness and Decision Making in Organizations. Jossey-Bass, San Francisco, pp. 204–261.
- Janis, I.L., 1972. Groupthink. Houghton Muffin, Boston.
- Keller, R.T., 1986. Predictors of the performance of project groups in R&D organizations. Academy of Management Journal 29, 715–726.
- Keller, R.T., 1997. Job involvement and organizational commitment as longitudinal predictors of job performance: a study of scientists and engineers. Journal of Applied Psychology 82, 539–545.
- Kichuk, S.L., Wiesner, W.H., 1997. The big five personality factors and team performance: implications for selecting successful product design teams. Journal of Engineering and Technology Management 14, 195–221.
- Lynn, G.S., Akgun, A.E., 1998. Innovation strategies under uncertainty: a contingency approach for new product development. Engineering Management Journal 10 (3), 11–17.
- Lynn, G.S., Morone, J., Paulson, A., 1996. Marketing and discontinuous innovation: the probe and learn process. California Management Review 38 (3), 8–37.
- Magjuka, R.J., Baldwin, T.T., 1991. Team based involvement programs: effects of design and administration. Personnel Psychology 44, 793–812.
- Mann, R.D., 1959. A review of the relationship between personality and performance in small groups. Psychological Bulletin 56, 241–270.
- Maznevski, M.L., 1994. Understanding the differences: performance in decision-making groups with diverse members. Human Relations 47, 531–552.
- McCrae, R.R., Costa Jr., P.T., 1989. The structure of interpersonal traits: Wiggen's circumflex and the five-factor model. Journal of Personality and Social Psychology 56, 586–590.
- model. Journal of Personality and Social Psychology 56, 586–590.

 Moreland, R.L., Levine, J.M., 1992. The composition of small groups. Advances in Group Processes 9, 237–280.
- Morgan Jr., B.B., Lassiter, D.L., 1992. Team composition and staffing. In: Swezey, R.W., Salas, E. (Eds.), Teams: Their Training and Performance. Ablex Publishing, Norwood, NJ, pp. 76–100.
- Moriarty, R.T., Kosnik, T.J., 1990. High-tech concept, continuity, and change. IEEE Engineering Management Review 3, 25–35.
- Mount, M.K., Barrick, M.R., 1995. The big five personality dimensions: implications for research and practice in human resources management. Research in Personnel and Human Research Management 13, 153–200.
- Neuman, G.A., Wright, J., 1999. Team effectiveness: beyond skills and cognitive ability. Journal of Applied Psychology 84, 376–389.
- Norman, W.T., 1963. Toward an adequate taxonomy of personality of personality attributes: replicated factor structure in peer nomination personality ratings. Journal of Abnormal and Social Psychology 66, 574–583.
- Oser, R.L., McCallum, G.A., Salas, E., Morgan Jr., B.B., 1989. Toward a definition of team work: an analysis of critical team behavior, NTSC Technical Report no. 89-018. Naval Training Systems Center, Orlando, FL.
- Reilly, R.R., McGourty, J.W. 1998. Performance appraisal in team settings. In: Smither, J. (Ed.), Performance Appraisal: State of the Art Methods for Performance Management. Jossey-Bass, San Francisco.
- Rosenbloom, R.S., Cusumano, M.A., 1987. Technical pioneering and competitive advantage: the birth of the VCR industry. California Management Review 29 (4), 51–76.
- Schneidner, F.W., Delaney, J.G., 1972. Effect of individual achievement motivation on group problem-solving efficiency. Journal of Social Psychology 86, 291–298.
- Schutz, W.D., 1955. What makes groups productive? Human Relations 8, 429–465.
- Schwartz, M.M., Aranoff, A., Reynolds, W.F., 1976. Responses of middle managers to case studies under conditions of homogeneous and heterogeneous stylistic grouping. Psychological Reports 38, 819–824.
- Shaw, M.E., 1981. Group Dynamics: The Psychology of Small Group Behavior. McGraw Hill, New York.
- Smith, P.G., Reinertsen, D.G., 1997. Developing Products in Half the Time: New Rules New Tools, 2nd Edition. Wiley, New York.
- Stevens, M.J., Campion, M.A., 1994. The knowledge, skill and ability requirements for teamwork: implications for human resource management. Journal of Management 20, 503–530.
- Stevens, G., Burley, J., Divine, R., 1998. Profits and personalities: relationships between profits from new product development and analyst's personality. In: Proceedings of the Paper Presented at the Annual Conference of the Product Development and Management Association, Atlanta, GA.
- Stevens, M.J., Jones, R.G., Fischer, D.L., Kane, T.D., 1999. Team performance and individual effectiveness: personality and team context. In: Proceedings of the Paper Presented at the 14th Annual Conference of the Society for Industrial and Organizational Psychology, Atlanta, GA.

- Strube, M.J., Keller, N.R., Oxenburg, J., Lapido, D., 1989. Actual and perceived group performance as a function of group composition: the moderating role of types A and B behavior patterns. Journal of Applied Social Psychology 19, 140–158.
- Sundstrom, E., De Meuse, K.P., Futrell, D., 1990. Work teams: applications and effectiveness. American Psychologist 15, 120–133.
- Tett, R.P., Jackson, D.N., Rothstein, M., 1991. Personality measures as predictors of job performance: a meta-analytical review. Personnel Psychology 44, 703–742.
- Tett, R.P., Jackson, D.N., Rothstein, M., Reddon, J.R., 1994. Meta-analysis of personality and job performance relations: a reply to Ones, Mount, Barrick, and Hunter. Personnel Psychology 47, 157–171.
- Thoms, P., Moore, K.S., Scott, K.S., 1996. The relationship between self efficacy for participating in self-managed work groups and the big five personality dimensions. Journal of Organizational Behavior 17, 349–362.
- Triandis, H.C., Hall, E.R., Ewen, R.B., 1965. Member heterogeneity and dyadic creativity. Human Relations 18, 33–35.
- Tuckman, B.W., 1967. Group composition and group performance of structured and unstructured tasks. Journal of Experimental Social Psychology 3, 25–49.
- Tupes, E.C., Christal, R.E., 1961. Recurrent personality factors based on trait ratings, ASD-TR-61-97. Aeronautical Systems Division, Personnel Laboratory, Lackland Air Force Base, TX.
- Tushman, M.L., Anderson, P., 1986. Technological discontinuities and organizational environments. Administrative Science Quarterly 31, 439–465.
- Watson, D., Tellegen, A., 1985. Toward a consensual structure of mood. Psychological Bulletin 98, 219–235.
- Watson, W.E., Kumar, K., Michaelson, L.K., 1993. Cultural diversity's impact on interaction process and performance: comparing homogeneous and diverse task groups. Academy of Management Journal 36, 590–602.
- Weick, K.E., Penner, D.D., 1969. Discrepant membership as an occasion for effective cooperation. Sociometry 32, 413–424.
- Whetten, D.A., 1989. What constitutes a theoretical contribution? Academy of Management Review 14, 490–495.Whitney, J.C., Smith, R.A., 1983. Effects of group cohesiveness on attitude polarization and the acquisition of knowledge in strategic planning context. Journal of Marketing Research 20, 167–176.
- Zander, A.F., Forward, J., 1968. Position in group, achievement motivation, and group aspirations. Journal of Personality and Social Psychology 8, 282–288.
- Ziller, R.C., 1955. Scales of judgement: a determinant of accuracy of group decisions. Human Relations 8, 153–164.