

Team Structuring Based on Personality and Emotionality Traits for Better Project Performance

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Group assignments are an important aspect of engineering and construction curriculum, which help students build their skillset in collaboration, teamwork, and communication. GPA, GRE, TOEFL scores, or other grading scale which reflect student academic performance, have been used in grouping student. Many previous researches have also been conducted to determine the relationship of team's performance using similar grouping mechanisms. Similarly, only a limited number of studies examine performance in a team setting, using personality instruments, (i.e. Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, Openness to Experience (HEXACO) - Altruism and Emotional Intelligence (EI)). In this study, 269 students from different universities across the United States were grouped into 48 teams and filled out the HEXACO-PI-R survey and took the Emotionality Quotient (EQ) test. The results from these surveys were statistically analyzed using Kruskal-Wallis H test, to determine if there was a relationship between the diversity in team personality and emotionality scores with their performance. The results from the test revealed that teams with higher variation in self-management and self-awareness scores performed relatively better in a team setting, than they did individually. Further analysis was carried out to determine the positioning of variation in scores on the instrument scale. No significant results were found for it. The methodology and results of this study adds both to the body of knowledge and professional field.

Key Words: Personality Traits, Emotionality Traits, Performance, HEXACO - Altruism, Emotional Quotient, Kruskal-Wallis H test, Team.

Introduction

Team work is important for any industry, including the construction industry. However, many engineering programs lacks teamwork development (Seemiller and Murray 2013). Previous researches have shown that the performance of construction management and engineering students in collages directly correlate to their performance in the construction industry (Naveed et al., 2017). Similarly, skills and performance of construction managers correlates to the success of construction project (Ahmed et al., 2014). Hence, skills and techniques students learn in colleges shape them into better construction managers. Previous literature has analyzed student's performance using academic achievements such as; high school grade, college entrance exam (Scholastics Assessment Test (SAT), American College Testing (ACT), Graduate Record Examination (GRE), Grade Point Average (GPA), and subject-specific test scores (Wait and Gressel, 2009). Moreover, substantial amount of research has also been conducted on personality and emotionality traits to predict different factors. However, all these studies were focused on students' individual performances, while, very little research has been conducted to predict academic performance using personality and emotionality traits in a team setup. Delivering to this gap in knowledge, this study investigates the relationship between the personality and emotionality traits with student performance in team setup.

Literature Review

The body of knowledge in this area was filled with studies which compare the academic performance of college students with different academic scales such as high school grade, college entrance exam (Scholastics Assessment

Test (SAT), American College Testing (ACT), Graduate Record Examination (GRE), Grade Point Average (GPA), and subject-specific test scores. (Wao et al. 2016) analyzed the relationship between GRE scores and academic performance (GPA) among construction management students. The result had not indicated any conclusive evidence of a relationship. Similarly, a study focused on engineering students, found verbal and quantitative sections of GRE to be significant in predicting students' academic performance (Holt et al., 2006). For engineering students, TOEFL scores have also shown to have a weak relationship with student performance (Wait and Gressel, 2009).

There have also been studies on students' performance with personality and emotionality traits. HEXACO has been used as a predictor for psychology student's performance, where the results showed Conscientiousness to be a significant factor (McAbee et al., 2014). Emotional Intelligence has also been used to predict the performance of nursing students (Fernandez et al., 2012). Literature on construction management and engineering students' performance with personality and emotionality traits were mostly limited at individual level. Similarly, among construction management and engineering students Conscientiousness and Altruism were determined to be the significant factors (Shalwani et al., 2018). Furthermore, Emotional Intelligence has also been used to predict student performance. In their study, (Mischung et al., 2015) showed that construction management students when given training in emotionality intelligence showed better performance.

Other various studies have determined the relationship between, personality and emotionality traits and various other factors in academics. HEXACO has been used for undergraduate students, to predict their risk preference knowing potential gain or loss for that risk. This study indicated Honesty/Humility, Emotionality, and Consciousness to be significant in factors (Weller and Thulin, 2012). Moreover, NEO five-Factor Inventory has been used to predict the retention of persisting first year engineering students. The results showed consciousness as the only significant factor (Hall et al., 2015). There was limited understanding of the relationship between personality and emotionality traits with performance, in a team setting.

Furthermore, different industry research has also been conducted to determine the relationship of various different factors with personality and emotionality traits. For instance, in the tourism industry, Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, Openness to Experience (HEXACO) has been used to predict performance, with Extraversion, Agreeableness, Conscientiousness, and Openness to Experience, found to be significant (Sohn and Lee, 2012). As investigated by (Slaski and Cartwright, 2002), the relationship between Emotional Intelligence and performance using retail managers' management personnel. The study indicated that higher Emotional Intelligence results in better management performance. In the construction industry, EI has also been used to measure the performance of project managers, concluding that EI was more related to relational performances dimensions than cognitive task related dimensions (Lindebaum and Cassell, 2010).

Point of Departure and Research Questions

Better teamwork leads to higher quality performance in the company's activities in general (Mitropoulos and Cupido, 2009), including the construction industry where team work is considered to be an important skill in the construction sector (Natishan et al., 2000). Teamwork being so critical in industry, there is a general consensus amongst the industry professionals that many universities in the United States do not focus on teamwork (Seemiller and Murray, 2013). Educational strategies have been blamed for not preparing engineering students to work in a collaborative environment (Kalonji, 2005). Despite this recognition that teamwork is an important contributor of team performance research on factors that predict the team's performance is scarce. Therefore, the first objective of this study was to determine the personality and emotionality traits that can enhance team's performance compared to individual students' performance.

Research Question 1) Was there a statistical significance between the spread in personality trait scores and individual performance in team settings?

The first research question analyzes the spread in scores for personality and emotionality trait, which was measured using coefficient of variation (CV). The top 25% and the bottom 25% were compared using Kruskal-Wallis H test to determine if there was a difference in scores for the two groups. With respect to performance, top 25% translate to the top 11 teams in the sample size, whereas bottom 25% were bottom 11 teams in the sample size.

The second objective of the study was to find the positioning of the variation in scores on the instrument scale. In much simpler words, the objective of the study was to determine the factor score where the variation in scores from the previous would have to be in order for significant performance in team setup. This would streamline the efforts of the instructor when assigning groups. Which led to the development of second research question.

Research Question 2) Where does the variation in score lies on the instrument scale?

The second research question further analyzes the relationship of personality and emotionality traits with performance in team setup. Further inferential testing was done to determine the factor score for different personality and emotionality domain, where the variation in scores would have to be for teams to perform relatively better in team setup.

Methodology

Data Collection

269 students in different construction management and engineering programs from different universities across the United States participated in this study. Out of 269, 216 were male and 50 were female, while 3 chose not to reveal their gender. These students were surveyed in the spring and fall of 2015, and the spring of 2016. These 269 students were grouped into 48 teams, for their respective courses' project work. These groups were formed at random, without the use of any metric, in order to minimize the influence any external factors. At the end of the semester, they were asked to fill out the personality trait survey, HEXACO - Personality Inventory - Revised (HEXACO-PI-R), and the Emotional Intelligence (EI) was measured using Emotional Quotient (EQ) test. Student performance was measured using their exam score and project score for the given class.

Variables

HEXACO-PI-R (HEXACO and Altruism)

The Big Five model has been the most predominant instrument used to measure personality traits. However, in the last decade, studies using lexical method of personality structure have found one more dimensions of personality, in the form of Honesty/Humility (Lee and Ashton, 2004). HEXACO personality has been used in various fields, ranging from medicine (Mckay and Tokar, 2012), political sciences (Chirumbolo and Leone, 2010), to education (Noftle and Robins, 2007). HEXACO-PI, where PI stands for Personal Inventory, was initially developed as a 200 items survey. Later on, this instrument was renamed as HEXACO- Personal Inventory – Revised (HEXACO-PI-R), and was made available with 100 and 60 items, with Altruism as an interstitial dimension. This study has used HEXACO-PI-R with 100 items, where each dimension had 16 items, and each of the 4 facets under all dimensions having 4 items each. Altruism was also measured using a 4-item response (Lee and Ashton, 2018). The responses to HEXACO-PI-R was on a Likert scale of 1 to 5. The factor score for HEXACO-PI-R surveys were also in a range of 1 to 5.

HEXACO is the acronym for the six-personality domain, Honesty/Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience. Each of these domains have their own characteristics and consists of 4 facets each. High scores in Honesty/Humility shows that an individual avoids manipulating other individuals and are not interested in lavish wealth and luxuries. High scores in Emotionality indicate that the individual experiences anxiety to life's stresses, feels empathy, and get attached to people easily. High scores in Extraversion indicates that an individual feels optimistic about things, feels confident, and enjoys social gatherings, Conscientiousness related high scores indicate that the individual is better organizer of their time and physical surrounding, disciplined, and strive to achieve perfection in their tasks. Individuals with high scores in Openness to Experience tends to be absorbed in beauty of art and science, imaginative, and take interest in unusual ideas. Lastly, High scores in Altruism indicate that the individual is soft-hearted and avoid causing harm to others. Lower scores in all the domains represent the attributes that are opposite to that of high scores.

Emotional Quotient (EQ)

Emotional Intelligence (EI) was developed by Salovey and Mayer as a 133-item model to measure the intelligence. EI is considered to be different than general intelligence, which is referred to as Intelligence Quotient (IQ). (Salovey and Mayer, 1990). Studies have shown that EI increases with an increase in age (Goleman, 1995), and people can be trained to have higher EI to performance better (Mischung et al., 2015). Intelligence was measured using the Emotional Quotient (EQ) test. EQ consisted five domains: Self-Awareness, Self-Management, Social Awareness, Relationship Management, and overall EQ. EQ was measured using a 28-item test response on a Likert scale of 1 to 6. However, the factor scores of EQ have a range of values in between 0 to 160.

Coefficient of Variation (CV)

CV is a mathematical measure, which describes the spread in scores. CV was used to measure the spread of scores as it was a dimensionless quantity and can be compared amongst personality and emotionality traits which were measured on different scales. The team's personality and emotionality score were measured by averaging the personality and emotionality score for each team member's trait in that team. Descriptive for team score and team CV values are provided in Table 1 below. While, the individual performance in team setup was measured by differential of project score to the exam score (DPE), which was the percentage increase or decrease in project score when compared to the exam score. The average of the DPE was the taken as the DPE for that team. With respect to performance, top 25% translate to the top 11 teams in the sample size, whereas bottom 25% were bottom 11 teams in the sample size. The top 25% of the sample were referred to as enhanced team performance, as the team on average performed better in project than in exam. The bottom 25% of the sample was referred to as decreased team performance, as the team on average performed better in exam than in project. These two groups were compared against each other to find factors that predict better performance in team setup.

Performance

There are many ways to measure the performance of students. Among these measures, high school grade, college entrance exam (SAT, ACT, GRE), grade point average (GPA), and subject-specific test scores are the most common (Wait and Gressel, 2009). In this study, performance was measured using a variable named Differential of Project Score from Exam Score (DPE).

Differential of Project Score from Exam Score (DPE): This variable indicates how much better or worse, a student performed in their project, compared to their exam score. The team DPE was then computed as the average DPE of all the team members. Team DPE represented the average of all teams members performance in project (team) compared to the exam (individual). Inferential testing was conducted for the the top quartile (top 25%), referred to as enhanced team performance, and the bottom quartile (bottom 25%), referred to as decreased team performance. The maximum and minimum differential achieved were, 37.07% and -10.57%, respectively.

Results

Descriptive Testing

Descriptive statistics for average team personality and emotionality trait scores, which includes HEXACO - Altruism, and EQ scores, were examined (Table 1). Descriptive statistics using measure of central tendency and measure of spread was conducted to visualize the pattern in scores for each of the traits. Descriptive statistics for personality trait CV values were also examined. Every domain of personality trait had a median value of more 3 out of a maximum of 5. Median values were used to conduct inferential testing.

Table 1. ***Descriptive analysis for team personality score and CV values***

Personality Traits	Team Personality and Emotionality Score						Team Personality and Emotionality CV Value					
	N	Max.	Min.	Mean	Median	S. Dev.	N	Max.	Min.	Mean	Median	S. Dev.
Honesty/Humility	48	3.88	2.88	3.23	3.22	0.22	48	27.82%	15.09%	18.79%	19.52%	6.57%
Emotionality	48	3.52	2.10	2.97	3.00	0.27	48	39.93%	7.69%	13.96%	9.58%	12.12%
Extraversion	48	3.98	2.84	3.43	3.44	0.24	48	22.37%	1.83%	11.30%	9.48%	7.13%
Agreeableness	48	3.53	2.56	3.03	3.01	0.24	48	33.96%	4.15%	16.66%	15.24%	10.13%
Conscientiousness	48	4.22	3.22	3.64	3.63	0.24	48	32.54%	5.97%	11.44%	8.57%	7.85%
Openness to Exp.	48	3.80	2.66	3.33	3.35	0.26	48	29.95%	6.27%	15.54%	15.18%	8.84%
Altruism	48	4.13	2.63	3.54	3.50	0.29	48	32.83%	11.46%	16.60%	15.23%	10.16%
Self-Awareness	48	89.00	57.00	74.89	72.92	6.77	48	18.57%	8.31%	11.38%	10.63%	4.63%
Self-Management	48	91.33	61.00	73.17	73.25	6.04	48	37.20%	1.44%	14.24%	13.38%	9.79%
Social Awareness	48	88.50	57.00	72.59	72.50	6.53	48	31.99%	6.75%	14.71%	13.77%	7.35%
Relationship Mng.	48	86.33	60.00	72.62	72.75	6.81	48	36.92%	4.26%	16.56%	12.69%	9.01%
Overall EQ	48	87.50	61.88	73.32	73.81	5.39	48	28.53%	5.57%	12.53%	11.55%	6.24%

Inferential Testing

To answer the first research question, Kruskal-Wallis H test was used to determine if there was a difference between CV values for students that performed better in a team setup. Kruskal –Wallis H test was used as an inferential test because the personality and emotionality score were not normally distributed, and Kruskal-Wallis H test does not assume for normality. Also, the sample size had a few outliers, and because Kruskal-Wallis H test compares the median values, rather than the mean values, the test was not affected by the outliers. The results were statistically significant for Self-Awareness and Self-Management at p-values of 0.043 and 0.040, at 0.05 level of significance. The result showed that higher the CV value of Self-Awareness and Self-Management, individual had performed significantly better in a team setup than individually. No other domain was found to be significant at 0.05. However, Honesty/Humility and Emotionality becomes significant at 0.1 level of significance.

Table 2. ***Kruskal-Wallis H test for team with diversity in personality and emotionality traits***

Personality Traits	Enhanced Project Performance		Diminished Project Performance		*p*-value
	N	Median	N	Median	
Honesty/Humility	11	12.40%	11	19.52%	0.096
Emotionality	11	18.03%	11	9.58%	0.059
Extraversion	11	15.76%	11	9.48%	0.207
Agreeableness	11	12.15%	11	15.24%	0.213
Conscientiousness	11	10.84%	11	8.57%	0.538
Openness to Experience	11	13.04%	11	15.18%	0.502
Altruism	11	12.50%	11	15.23%	0.746
Self-Awareness	11	17.62%	11	10.63%	0.043*
Self-Management	11	15.98%	11	13.38%	0.040*
Social Awareness	11	13.32%	11	13.77%	0.880
Relationship Management	11	17.13%	11	12.69%	0.543
Overall EQ	11	11.84%	11	11.55%	0.483

*Significance at $p<0.05$

The second research question ,a successor to the first research question, determines where the CV values lie on the instrument scale. Kruskal-Wallis H test was conducted to determine the positioning of the CV value. The result showed no significance for any of the domains, even for domains found significant in earlier test.

Table 3. ***Kruskal-Wallis H test for positioning of CV value on the instrument scale***

Personality Traits	Top Quartile		Bottom Quartile		*p*-value
	N	Median	N	Median	
Honesty/Humility	11	3.13	11	3.19	0.712
Emotionality	11	3.16	11	2.77	0.151
Extraversion	11	3.25	11	3.25	0.150
Agreeableness	11	2.94	11	3.04	0.191
Conscientiousness	11	3.64	11	3.71	0.463
Openness to Experience	11	3.41	11	3.38	0.900
Altruism	11	3.44	11	3.63	0.526
Self-Awareness	11	77.67	11	72.00	0.307
Self-Management	11	70.50	11	74.33	0.276
Social Awareness	11	72.75	11	73.67	0.931
Relationship Management	11	72.50	11	72.00	0.963
Overall EQ	11	74.44	11	74.08	0.921

*Significance at $p<0.05$

Discussions

The overarching objective of this study was to determine if a grouping individual using personality traits in a specific way enhances their team performance as compared to their individual performance. This led to the development of the first research question that examined if there was a statistical difference between the spread in personality trait scores, with team performance. Table 2 shows that teams with a higher spread in scores of Self-Awareness and Self-Management have statistically performed better in team settings, relative to individual settings. Therefore, if a team has a wider variation in scores for team members, as opposed to clustered scores for self-awareness and self-management, such teams had a relatively better performance in team setups. At higher level of significance, of 0.1, Honesty/Humility and Emotionality were also found statistically significant. Lesser the variation in scores for Honesty/Humility, while, higher variation in scores for Emotionality led to relatively better performance in team setup. Similar to previous research which has showed that emotionality and personality traits have effect on individual performance, the results of this study shows that the aggregate personality and emotionality scores of teams have effect on the performance as well.

The second research question was a successor to the first research question which aimed to determine where the variation in score lies on the instrument scale. The analysis conducted showed that higher variation in scores for Self-Awareness led to a statistically better performance in team setup. However, we do not know if the variation in scores are to be at the lower end, upper end, or somewhere in the middle of scale. This led to development of the second research question, to determine where the variation in score lies on the instrument scale for statistically significant results. Table 3 showed that there was significant difference between enhanced team performances with personality trait scores. The inference drawn from analysis conducted was that the variation in score was independent of positioning in scale. However, increasing the project team sample size could provide a robust test and results.

Conclusions

Teamwork is an important aspect in any industry. However, many universities in the United States have a limited focus on teamwork. Similarly, in the construction industry, team building and collaboration is considered to be an important factor for better project performance. A number of previous studies have aimed in identifying factors that predict individual academic performance, with only a few studies focused on predicting factors that effect performance of students in team settings. This study analyzed 269 students, grouped in 48 teams, to determine the relationship between their personality traits to their performance in a team set up. DPE was the performance measure used, which indicates the performance of students in a team setup compared to their individual performance.

The results of the study showed that higher variation in Self-Awareness and Self-Management scores led to a relatively better team performance. Therefore, the teams, which had members with diverse scores in Self-Awareness and Self-Management traits, performed better in a team setup when compared to individual settings. In addition to this result, it was important to find where the variation in scores had to be on the instrument scale, to allow an enhanced team performance. Further analysis revealed no significant results for any of the personality or emotionality traits with regard to positioning of scores on instrument scale. Therefore, it was concluded that higher variations in scores for Self-Awareness and Self-Management, irrespective of the positioning on the instrument scale, provides relatively better performance in team setup.

This study adds to the body of knowledge by analyzing the relationship of team performance with emotionality and personality traits. Furthermore, similar methodology can be applied to different disciplines for future research. This study also adds to the professional field, as the results of this study can help instructors formulate groups using personality traits, that can help teams perform better in classroom settings. Lastly, the same methodology can be expanded into other industry professionals, including construction industry, to predict the project team's performance using the personality and emotional trait.

However, there were a number of limitations to this study. The study only analyzed construction management and engineering students. Future research can analyze construction management and engineering students separately. Furthermore, the sample size for this study was relatively small. Future research can have larger sample size, which can help provide robust test results.

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