

## **Analyzing the Group Effectiveness and Dynamics of a Heterogeneous International Research Group In Cartagena (Colombia): A Case Study**

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## Analyzing Group Effectiveness and Group Dynamics of a Heterogeneous Group: An International Team Case Study

### Abstract

Group activities are commonly employed in education. Groups that comprise members of different ethnicities, cultures and races make up the characteristics of a heterogeneous group. A case study was conducted on group dynamics to explore the different variables that influence group effectiveness. The effectiveness of the group was accessed by the big five personality traits and eight dimensions of group effectiveness with a selective sample of engineering undergraduate students. This research was part of an international research project in Colombia, Cartagena. Eight engineering students participated in this intensive international research abroad for two months in environmental research. The research project required students to work together in groups from multidisciplinary backgrounds (environmental engineering, environmental earth science, chemical engineering, and mechanical engineering) to solve problems pertaining to environmental research in an international setting. The purpose of this research is to establish a root understanding of group dynamics with an internationally diverse population. This case study is based on data obtained from direct qualitative observations and questionnaires to determine the factors related to group effectiveness. This paper intends to explore the nature of group dynamics within the context of international research with a multicultural/multiracial group of eight students.

**Keywords:** *group dynamics, group interactions, BFPTSQ, international heterogeneous group, international research.*

## **Introduction**

Humans are known to be social creatures and thus group interaction is a ubiquitous feature of human nature. The literature demonstrate a concise understanding of group dynamic, primarily when investigating homogeneous groups [1, 2]. Yet, little empirical research has been devoted to international heterogeneous groups composed of different ethnicities and races, namely to how these differences effect group effectiveness. Therefore, this research tries to narrow this gap and shed light on an exploration of international group analysis. At best, this research may serve as an engine to initiate more research with non-European American groups and understand the expansive nature of human relations and interaction within international heterogeneous groups' domains.

The aim of this paper is to examine the group dynamics of an international research group composed of heterogeneous members. In this study, group dynamics refer to group effectiveness which is defined as the effective outcome [3, 4, 5, 6], quality of team performances and members' satisfaction [6]. Group effectiveness requires the implicit development of different integrated skills [7, 8] to avoid dysfunctional and inefficient groups, some of these skills pertain to personality, understanding of groups' purpose and goals, roles, team processes, team relationships, intergroup relations, problem-solving, passion and commitment, skills and learning. Additionally, members of a group have different personalities that influence group dynamics. Group effectiveness and members' personalities are not mutually exclusive factors and thus they need to be studied cohesively. The big five personality traits examine group members' personalities, which can be divided into five traits: extraversion, openness, conscientiousness, agreeableness, and neuroticism [9, 10]. These five personality traits can be seen across cultures [10] and are essential factors that predict specific groups' roles, such as leadership [10, 11], individual performances [12] and group' behavior [10, 12]. However, the big five traits are not correlated with intelligence [13] and thus it is not a direct factor that impact group effectiveness. Groups and individual observations along with modified and established surveys of group dynamics were conducted to determine the impact that heterogeneous groups composed of different races, ethnicities, and cultures have on group effectiveness and process.

## **Background**

### *Cartagena Project*

This research was part of an international research project to monitor the environmental quality of historically known ecosystems of fisheries and beaches in Cartagena, Colombia. The environmental research and data analysis for this project took place at Universidad San Buenaventura in Cartagena, Colombia. The environmental research was completed by students collaborating in teams. Initially, students were assigned to a specific group and then students were allowed to form their own team with the requirement of reorganizing team structure when activities change. Hence, students were not allowed to constantly work with the same members in different activities or have the same roles. The project consisted of students writing weekly research reports, cultural reports, and individual research reports. Students tested parameters relating to environmental quality such as pH, phosphate, iron, sulfate, nitrate and fecal coliform.

Sample collections were taken from two beaches in Cartagena (Boquilla and Manzanillo) and from three rural underdeveloped communities Tierra Baja, Puerto Rey, and Zapatero [14, 15].

The Cartagena group met Mondays through Saturdays for eight weeks, eight hours a day, and Saturdays for three hours a day. The research coordinator was also present but minimized her interaction with the group. The students received a group grade evaluation from the project's instructor.

## Methods

**Participants.** For the summer of 2017, there were a total of eight participants. Participants' original names were changed to pseudonym names for confidentiality purposes. The pseudo names are Juan, Dianna, Erika, Jessica, Aria, Jake, Mario, and Alberto. All participants provided sociodemographic information such as gender, age, level of education, institution type and student's major (see table 1). There was a disparity in language, 62.5% of the group was fluent in Spanish and 50% of the group was fluent in English.

The institutions that students attended during this project are: Ivy league-private University of Pennsylvania School of Engineering and Applied Science, Lincoln University which is a Historically Black College and Universities (HBCU)-public, City College of New York which is a minority-serving institute (MSI)-public, and Universidad San Buenaventura which is Colombian catholic-private institute, Universidad Tecnologica de Bolivar is a Colombian private institute. Finally, Universidad de Cartagena which is a Colombian-public institute.

Table 1. Participants' demographics

Students	Genders	Ages	Nationalities	Races	Programs	Universities	Academic Levels	Universities' Designations
Juan	Male	21	Colombian	Hispanic	Chemistry	U.C.	8th semester	Public Institution
Dianna	Female	21	B./A.A	B./A.A	E.E.S	C.C.N.Y.	9 <sup>th</sup> semester	Public Institution
Erika	Female	18	B./A.A	B./A.A	M.E	P.E.	3rd semester	Ivy League/ Private
Jessica	Female	20	D.A	Hispanic	Biology	C.C.N.Y	5th semester	Public Institution
Aria	Female	23	Colombian	Hispanic	C.E	U.S.B.	9th semester	Private Catholic Institution
Jake	Male	24	B./A.A	B/A.A	E. E.	L.U.	Graduated	Public Institution
Mario	Male	22	Colombian	Hispanic	C.E	U.S.B.	9th semester	Private Catholic Institution
Alberto	Male	20	Colombian	Hispanic	E.E	U.T.B.	8th semester	Private Institution

Table 1. Shows important information about the Cartagena heterogeneous group members. Note: B.=Black, A.A=African American, D.A= Dominican American, E.E.S= Environmental Earth Science, C.E= Chemical Engineering, E.E=Environmental Engineering, M.E= Mechanical Engineering, U.C=Universidad de Cartagena, C.C.N.Y.=City College of New York, P.E.=Penn Engineering, U.S.B= Universidad de San Buenaventura, L.U=Lincoln Universidad, U.T.B= Universidad Tecnologica de Bolivar.

**Survey Tools Used.** One of the measurements used in this paper was the big five personality trait short questionnaire (BFPTSQ) [16]. It contained 44 items on a Likert-type response with a 5-point scale (totally agree = 5, agree a little = 4, neutral opinion = 3, disagree a little = 2 and disagree = 1). The BFPTSQ assesses the factors of personality known as extraversion, agreeableness, conscientiousness, openness, and neuroticism (See table 2 for full description).

The range for each personality trait is 1, which represent 20%, to 5, which represent 100%. For instance, the minimum score that participants can obtain in a specific personality trait is 20% and the maximum that they can obtain is 100%. The data was obtained from the number of items (questions) related to each trait. The total sum of each personality trait was obtained, then the average for each total trait was calculated. Results were multiplied by 100 to convert the final data to percentages.

The Team Effectiveness Questionnaire (TEQ) is a measurement tool that accesses group effectiveness within eight dimensions [17]. The dimensions accessed by the TEQ are a) purpose and goal, b) roles, c) team processes, d) team relationships, e) intergroup relations, f) problem-solving, g) passion and commitment, h) skills and learning (see table 2 for full description). The questionnaire contained 56 questions answered on a 5-point Likert-type scale (strongly agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Disagree Strongly = 1). In the TEQ each dimension is composed of eight statements with a maximum score of 35 and a minimum score of 7. The final average score for each dimension was obtained by adding the eight participants' scores and dividing it by the total final score, then the final score is multiplied by 100 to convert the number to a scale of 20-100.

**Observations.** Day to day activities were observed in the group from 8:00 AM to 6:00 PM. Notes were taken each day, reviewed and cataloged to use to bring context and depth to survey findings.

**Data Analysis.** The data was coded and processed using Excel, SPSS and R statistics. The results of the study were carried out with R-Pearson correlation to investigate how the composition of heterogeneous groups are related to group performances. The expected outcome for this statistical method is a positive/negative linear relationship between variables related to group effectiveness in this heterogeneous group. Pearson correlation provides an accurate analysis to find significant relationships between variables and thus it is an accurate method to use for this study.

Survey Tool	Item No.	Domain Name	Description	Reference
BFPTSQ	1	Extraversion	talkative, assertive, sociable, and energetic	10, 12, 16, 18, 19, 20
BFPTSQ	2	Agreeableness	good-natured, cooperative, forgiving and trustful	10, 12, 16, 18, 19, 20
BFPTSQ	3	Conscientiousness	responsible, orderly and dependable	10, 12, 16, 18, 19, 20
BFPTSQ	4	Openness	independent-minded, intellectual and imaginative	10, 12, 16, 18, 19, 20
BFPTSQ	5	Neuroticism	anxiousness, easily upset, not self-confident, and irritable and shy	10, 12, 16, 18, 19, 20
TEQ	a	Purpose & Goals	tasks' outcome	21, 22

TEQ	b	Roles	position taken for specific task	21, 23
TEQ	c	Team Processes	group' collective goal-directed task work	22, 24
TEQ	d	Team Relationships	connection or interdependence among the team members	17, 25
TEQ	e	Intergroup Relations	interactions between and among group members	17, 26, 27, 28
TEQ	f	Problem Solving	analysis & effective solution	28, 29, 30, 31
TEQ	g	Passion & Commitment	strength & positive feeling related to team identity and performance	3, 4, 32, 33,
TEQ	h	Skills & Learning	development and understanding of different activities	5, 6, 28, 34,

Table 2. Provides the scholarly definitions for the big 5 personality traits and the eight dimensions of team effectiveness questionnaire.

## Results

**Big Five Personality Traits.** Figure 1 shows scores related to the big five personality traits. Most of the participants had higher scores within the traits of agreeableness and conscientiousness. In addition, the trait neuroticism was about 50% or less for all participants. The trait openness had similar scores for all participants.

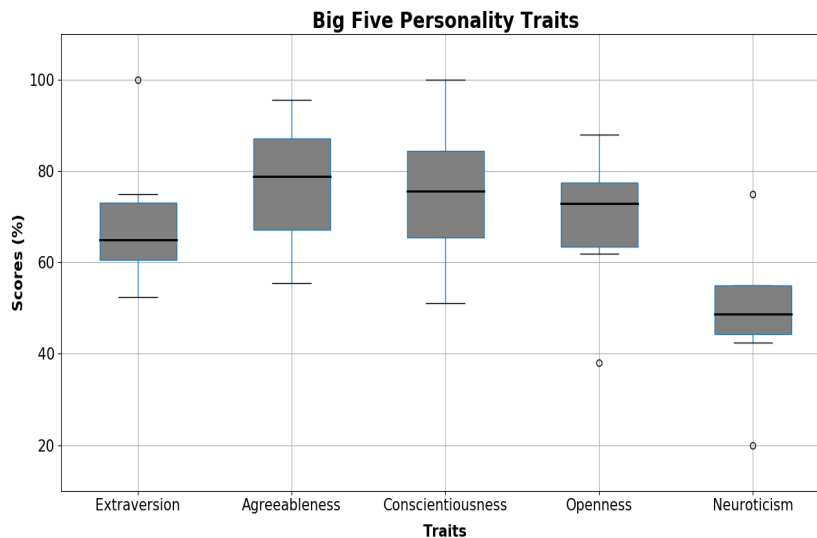


Figure 1. Shows the big five personality traits. The overall score for agreeableness is the high score compared to the other four traits, also conscientiousness scores were the most spread compared to the other traits.

A correlation between the big five personality traits demonstrate interesting results (see table 3). Pearson correlation shows a significant positive relation between agreeableness and conscientiousness  $r(6)=.753$ ,  $p=.031$ . Hence, results could be interpreted as students that scored

high on agreeableness were likely to also score high on conscientiousness. Agreeableness was also positively and strongly correlated with openness  $r(6)=.823$ ,  $p=.012$ . Thereby, results might suggest that an agreeable student was also more likely to be classified as open in the big five personality traits. Finally, the present study also found a relation between conscientiousness and openness  $r(6)=.813$ ,  $p=.014$ . Students that were classified as conscientiousness were also likely to be classified as open in the five personality traits.

### Big Five Personality Trait

Agreeableness	Pearson Correlation	.519			
	Sig. (2-tailed)	.188			
	N	8			
Conscientiousness	Pearson Correlation	.607	.753*		
	Sig. (2-tailed)	.11	.031		
	N	8	8		
Neuroticism	Pearson Correlation	-.624	-.257	-.544	
	Sig. (2-tailed)	.099	.540	.163	
	N	8	8	8	
Openness	Pearson Correlation	.685	.823*	.813*	-.255
	Sig. (2-tailed)	.061	.012	.014	.542
	N	9	9	9	8

Extraversion      Agreeableness      Conscientiousness      Neuroticism

\*. Correlation is significant at the 0.05 level (2-tailed).

Table 3. Shows the Pearson Correlation between the five big personality traits.

**Team Effectiveness Questionnaire (TEQ).** The average results of the TEQ survey are shown in figure 2, the lowest dimensions were c) team process, e) intergroup relations, and g) passion and commitment. The highest domain was roles with  $M=80$ ,  $SD=11.82$ , followed by purpose and goals  $M=77$ ,  $SD=13.82$ .

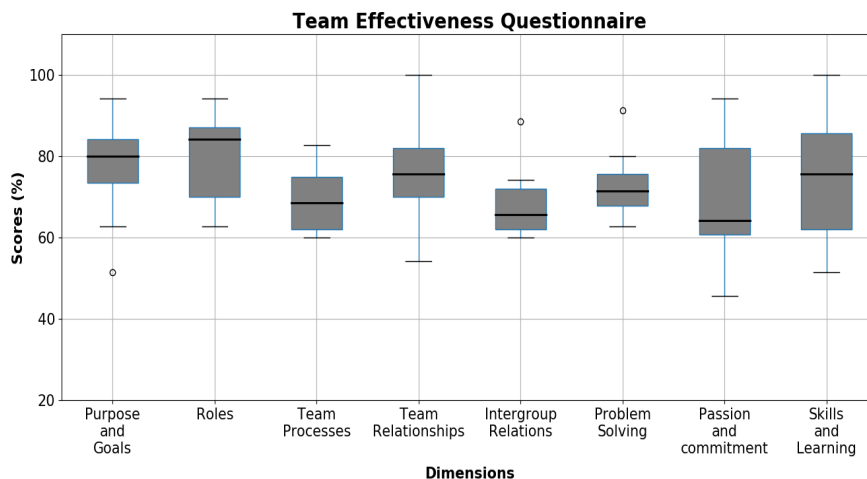
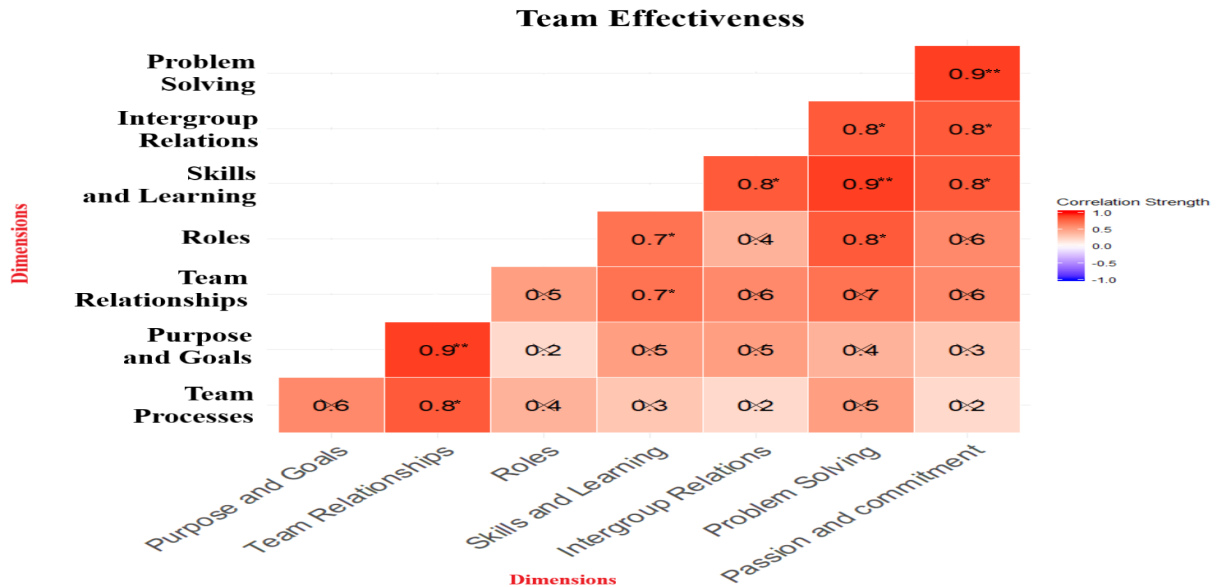


Figure 2. Shows the total scores for each dimension. Group effectiveness is based on eight dimensions: purpose and goals, roles, team process, team relationship, intergroup relations, problem-solving, passion and commitment, and skills and learning.

**Pearson Correlation with TEQ.** Pearson correlation was done within the eight dimensions of the team effectiveness questionnaire, see figure 3. The stronger correlations are related to problem-solving within the domain of roles, intergroup relations, passion and commitment, and skills and learning.



\*. Correlation is significant at the 0.05 level (2 tailed),  
 \*\*. Correlation is significant at the 0.01 level (2 tailed)

Figure 3. Show the significant and nonsignificant Pearson Correlations between the eight dimensions from team effectiveness questionnaire.

## Discussion

The purpose of the present case study was to identify factors related to group effectiveness in an international heterogeneous group. As figure 1 shows, the group scored high on agreeableness, followed by conscientiousness, extraversion, openness, and scored low on neuroticism. Agreeableness is one of the three main traits related to leadership, and thus due to the high scores of agreeableness in this group (see figure 2) one might expect for multiples leaders to emerge. However, only one particular student (Erika) emerged as the leader in this group. The group’s results in the big five personality traits embrace the important relations between roles and personality within group dynamics. Leadership emergence is specifically facilitated by high levels of extraversion and agreeableness [10]. The Pearson correlation for the big five personality traits showed a significant positive relation between agreeableness and conscientiousness. Hence, this result could be interpreted as agreeable students who were characterized by being cooperative, forgiving and trustful were likely to also be conscientious students characterized of being responsible, orderly and dependable. Agreeableness was also positively strongly correlated with openness. Thereby, such results might imply that an agreeable



student was likely classified as an openness student, which is characterized by being independent-minded, intellectual and imaginative.

In the TEQ the Cartagena heterogeneous group scored high on roles' understanding, and such finding related to roles demonstrated that the group has an adequate perception of roles. Each member understood the role that he/she played and other members' roles [35]. The domains of goals and purpose were also well understood in the group and to achieve group goals it was observed that each member worked collaboratively with each other. Passion and commitment, team processes and intergroup relations were the lower scores within the eight dimensions. However, the group was not ineffective within these three dimensions. For instance, the group effectively and quickly solved their group and individual problems, enhancing their group process and decision making [36, 37]. Furthermore, decision-making was mostly provided by the group leader which in the context of this group enhanced the group process. Unsurprisingly, team relationship obtained a higher score which reflects the group's main trait of agreeableness.

The Pearson correlation of the eight dimensions demonstrated various significant correlations. As figure 3 shows, purpose and goals were significantly and positively correlated with team relationship. Team relationship is related to how each member appreciates each other, listening to each other, communicate with each member and so forth. One interpretation for the significant statistically results within these domains is that the further members appreciate each other's input the more likely goals are going to be completed. Interestingly, group mutual understanding of roles were positive significantly correlated with problem-solving. Hence, one possible explanation is that as group' perception of roles' understanding increased, the group effectiveness in solving the problem increased simultaneously. Problem-solving was also significantly and positively correlated with intergroup relations. Such results might suggest that to effectively solve problems within this group, each member respected each other, supported each other, worked collaboratively and saw themselves as a unit of the group. Roles were significantly and positively correlated with skills and learning. One possible explanation to understand the results within these domains is that a clear understanding of roles enhanced skills and learning. Hence, the further group members understood their roles the more likely members enhanced their skills and learning abilities. Finally, it should be noted that individual personality characteristics were examined in relation to team effectiveness between the eight dimensions. But results did not yield any significant results related to personality traits and team effectiveness.

There are many challenges that this heterogeneous group faced in an international context, particularly emerging from cultural differences [38], language, education and so forth. Interestingly, the group showed sign of a "high power distant group" [38, 39], where one specific student held the power to make the group's vital decisions [38, 39, 40]. This group was characterized by having one leader. Erika took a lot of responsibilities of the work, such as communicating information to the research coordinator and sending emails to the director. Group members did not implement any initiatives without input from Erika, therefore, final decision-making and problem-solving were left to Erika. Erika emerging as the leader of the group was unanticipated due to age and academic gaps.

The distribution of power was unequally divided, but the leader of the group was competent and used her power for the benefit of the group by taking on many of the hardest responsibilities. In contrast with Paulus et al. [38], it shows that high power distance groups are also very efficient in their work. Miscommunication was one of the major limitations for this group, but one might expect such limitation in heterogeneous groups composed of multilingual students whose native languages are not the same. Arguably, in the present study differences in language, race and ethnicity did not create tendencies for ethnocentrism. Nonetheless, intra- and intergroup relation affected students' behavior creating ethnocentrism based on liking and feelings.

The group efficiently coordinated their roles, tasks and progress in the lab. Their work was efficient when the group worked together in the lab, but their individual reports did not reflect the same efficiency. Students work included lab analysis, individual research analysis, cultural reports, poster presentations, power points presentations, and presentation at a local conference. The increasing number of academic activities might have hindered members' individual reports. The group interaction did not create any exponential crisis since problem-solving was accurately implemented. Some problems that the group faced were mismanagement of personal money, lack of effective internet access, lack of transportation, and other conditions that added more fatigue and less time for rest. In retrospect, it would have been helpful to allow more time for the group to attend more cultural relaxing activities.

### **Limitation**

The limitations to this research are the small sample size and diversity as defined in this study of the heterogeneous group. The data provided in this study is self-reported from each member of the group. Observations for this study was noted on a day to day basis instead of by incident/task. In addition, other survey tools may produce different result.

### **Conclusion and Future Work**

This study is an initial model for group dynamics understanding and provides a structural view of the factors related to group effectiveness. This study recognizes the importance of understanding group dynamics in an international setting. The conclusions that can be drawn from group dynamics literature recognize the importance of social interaction in a group setting represented by different patterns of human behavior. Collectively members of a group represent the strength and weakness that can derail or enhance group effectiveness. The heterogeneous group may provide a substantial understanding of group dynamics since it provides the conditions through which conflict emerge easily compared to the homogeneous group. It seems that humans are more prone to conflict when differences denote the characterization of an interaction. This notion of heterogeneous conflict is especially poignant since group effectiveness is derailed by these conflicts.

There are many factors that this study could not analyze such as language and socio-economic status. Future studies should focus on the effect of language on group dynamics and how language can impact individual and group performances. Culture and ethnocentrism should also be the focus of future studies related to heterogeneous group dynamics. Moreover, models

that describe group dynamics need to include the potentially relevant properties of context, individual characteristics, intra and inter interaction, and the conditions that are embedded in these variables.

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