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Who are the Good Team Players: Part II

Richard Bannerot

Department of Mechanical Engineering
University of Houston

Abstract

Working in teams, especially on multidisciplinary projects, is becoming more and more common in engineering as well as in other work environments. However, despite the importance of "team-work" in engineering, there is little data on the characteristics of "good" and "poor" team players. This paper presents the second set of results from an ongoing, horizontal study of this issue in two engineering design courses, one at the sophomore level and the other at the senior level. The courses are offered each fall and spring, and results contained in this paper are based on the input obtained from 298 students working on 77 project teams over three semesters, fall 2002 through fall 2003. Individual demographic, academic, personality (Myers-Briggs type indicators) and personal data, as well as interest and skill level, were gathered from the six classes. The data for those individuals judged to be above average team players and those judged to be below average team players were then compared both to each other and to the class averages. Some of the conclusions reached are listed below:

- The better team players tended to be older, with more general and more engineering related work experience and either Caucasian or Hispanic.
- Females marginally outperformed males.
- The poorer team players tended to be younger, with less work experience, and non-Hispanic minorities.
- The better team players tended to have better drawing abilities and were better self-critics of their own drawing abilities.
- Factors appearing to have little influence were personality type, results from standardized testing, and high school and college grade point averages.
- The expressed motivation for the course or for working in groups, interest in the project, and a self assessment of ones own group's efficiency seems to have little influence on ones own performance in the group. Although the better team players indicated that they were "enjoying" the class more.

Introduction

A paper[1] presented at last year's ASEE GSW Annual Conference provided a methodology to determine the characteristics of "good" and "poor" team players in an engineering design setting. This methodology utilized a peer rating form taken from

Kaufman[2], the results from a demographic questionnaire, and a Myers-Briggs type temperament sorter[3] to determine the characteristics of "good" and "poor" team players. The data was based on the performances in two classes, a sophomore mechanical engineering design course and a multidisciplinary, senior, capstone design course, during the fall of 2002 and utilized the complete records of 92 students of the 103 initially enrolled in the classes (Five students dropped the classes.) working in 27 teams. Despite the limited data some preliminary conclusions were stated:

- Women tended to be better team players than men
- The better team players tended to be older, with more work and hands-on experience and either Caucasian or Hispanic.
- The better team players tended to have higher college and high school gpas and higher SAT Verbal scores but lower SAT Analytical scores.
- The better team players tended to have better drawing skills and were better self-critics of their own drawing abilities.

With the same methodology the data collection continued in these two courses for the spring and fall of 2003. Data has now been collected on 298 students working in 77 groups in these classes. The combined data set was reanalyzed. Some of the conclusions reached last year were confirmed while some others were shown to be unjustified.

Methodology

The questionnaire used was only slightly modified from last year[1]. The questionnaire was utilized to determine demographic, work related, and academic related information. In addition, the students were asked to state their degree of agreement or disagreement with nine statements related to working in groups and their feelings about the course. They were also instructed to provide a drawing sample. The questionnaires were given toward the end of the semesters in the classes. The peer evaluations, as well as instructor evaluations based on discussions with the groups and with individual students, were used to identify the "good" team players (averaging about 30% of the students) and "poor" team players (averaging about 20% of the students). The contents of the questionnaire will be obvious from the results to follow. Details of the Methodology can be found in the previous paper[1].

In the six classes a total of 298 students working in 77 groups (as noted above) were evaluated during three semesters: fall 2002, spring 2003, and fall 2003. One hundred twenty-six students, working in 32 groups were enrolled in the sophomore design class; the rest, in the senior capstone design course working in 45 groups.

A brief discussion of the previous work reporting on using various criteria to attempt to form effective design groups was given in the previous paper[1]. It was pointed out at that time that no previous study had been found that attempted to actually link an individual's performance in a group with his/her demographic and/or personality traits. However, there has been some conjectures on desirable individual traits, e.g., Myers-Briggs personality temperaments[4,5], but most of the interest has been focused on the proper "mix" of personalities, skill sets and academic performance [6,7,8] to "optimize" the group performance. However, none of these conjectures or studies provided much more than anecdotal comments or very unconvincing data to support them.

Results

The results of the current study are presented in the following tables in various formats. Because of the different nature of the two courses, most of the results are presented for two sets of students: all students and only the senior students. In the introductory sophomore design course about half the course grade is based on a semester long design, fabricate, and compete group activity[9]. In the senior capstone course, taken by three departments[10] (Electrical and Computer Engineering, Industrial Engineering, and Mechanical Engineering) in which students are forced to form groups with representation from at least two departments, about 65% of the course grade is determined by a semester-long project provided by local industry or the faculty. (Generally each group has a different project.)

The ethnicity data for all students are presented in Table 1. Four ethnic groups (as self reported) are recognized: Caucasian, Hispanic, Asian (east and south), African American, and Other (Middle Easterner, Pacific Islander and American Indian). The first column provides the distribution (per cent) of each ethnic group in the classes; the second column provides the distribution in the "good" team player category; the third, the range over the six classes; the fourth column provides the distribution in the "poor" team player category; and the fifth, the range. The range gives the lowest and the highest percent for each category for all six classes. For example, Caucasians comprised between 27% and 69% of the good players group in each of the six classes consider. For all the students considered in the six classes, there were 101 Caucasians that represented 34% of the 298 total students. Of the 88 students determined to be "good" team players, there were 40 Caucasians (45%). Of the 62 students determined to be "poor" team players, there were 15 Caucasians (24%). If we compare the probability of a particular ethnic group member being a "good" team player with the probability of his being a "poor" team player, we could conclude, for example, that Caucasians are about: 0.45*88/[0.24*62] = 2.7 times more likely to be a "good" team player than a "poor" team player, as indicated in the final column in Table 1.

	% of class N=298	good players as a % of all good players avg N=88	range	poor players as a % of all poor players avg N=62	range	
Caucasian	34	45	27 to 69	24	11 to 50	2.7 times more likely to be good
Hispanic	27	33	13 to 58	21	10 to 27	2.2 times more likely to be good
Asian	26	14	0 to 32	35	12 to 46	1.9 times more likely to be poor
African Am	9	3	0 to 9	11	0 to 28	2.5 times more likely to be poor
Other	4	5	0 to 13	10	0 to 20	1.4 times more likely to be poor

Table 1: Ethnic Distribution of All Students as Good and Poor Team Players

	% of class N=172	good players as a % of all good players avg N=46	range	poor players as a % of all poor players avg N=31	range	
Caucasian	27	42	27 to 55	17	11 to 28	2.5 times more likely to be good
Hispanic	26	24	13 to 36	23	10 to 27	1.1 times more likely to be good
Asian	32	22	0 to 32	43	25 to 46	1.9 times more likely to be poor
African Am	9	4	0 to 9	10	11 to 28	2.3 times more likely to be poor
Other	6	7	0 to 13	7	0 to 11	equally likely

Table 2: Ethnic Distribution of Capstone Students as Good and Poor Team Players

Table 2 contains the same information as Table 1 but for the capstone students. Both the Caucasian and Hispanic students seem to be better team players that other two ethnic groups.

The gender data for all students and for just the capstone students is presented in Table 3.

All	% of class N=298	good players as a % of all good players avg N=88	range	poor players as a % of all poor players avg N=62	range	
Male	76	72	50 to 86	76	60 to 100	1.3 times more likely to be good
Female	24	28	15 to 50	24	0 to 40	1.7 times more likely to be good
Capstone	N=172	N=46		N=31		
Male	80	83	77 to 86	74	60 to 90	1.6 times more likely to be good
Female	20	17	13 to 22	26	10 to 40	1.1 times more likely to be good

Table 3: Gender Distribution of All and Capstone Students as Good and Poor Team Players

The female students do slightly better than the males in the group environment. The drop in female group participation in the capstone course may be attributed to the larger fraction of Asian and African American females in the capstone course than in the sophomore course.

The effects of age and the length and type of work experience are given in Table 4 for all students and for only the capstone students. Two work types were identified: “any work” and “engineering related work”. The average age for each of the two categories of students is given in the first column. For the good and poor players the age in years older or younger than the average age (in column 1) is given. Age and work experience appear to be the most consistent predictors of team performance with all classes except two (in one sophomore class the average age and general work experience of the “good” team players was below the class average) following the “average pattern”.

Age	average (years)	good players	poor players	difference between good and poor (years)	range of differences (years)
All classes (N=298)	22.6	0.68 years older	1.71 years younger	2.4 older	(0.7) to 3.4
Capstone (N=172)	25.2	1.34 years older	0.76 years younger	2.1 older	1.8 to 2.4
General work Exp					
All classes (N=298)	5.05	5.51	3.96	1.5 years more work	(0.3) to 3.9
Capstone (N=172)	5.32	6.38	4.83	1.6 years more work	
Eng'g Work Exp					
All classes (N=298)	1.44	1.98	0.76	1.2 years more work	0.3 to 1.8
Capstone (N=172)	1.67	2.35	1.12	1.2 years more work	

Table 4: Effects of Age and Length and Type of Work Experience

There is a significant age difference between the two classes. This issue was not pursued, e.g., it could be related to major (three majors in the capstone course, dominated by the electrical engineering students compared to only mechanical engineering students in the sophomore course). Even so, the average age and average length of work experiences differences between good and poor team players were remarkably consistent.

As noted in the previous paper[1] there appeared no strong relationship between an individual’s performance on a team and the Myers-Briggs temperament indicators (MBTI). However the results for both the classes are shown separately in Table 5. The combined result is not shown. These results seem particularly unremarkable and, in fact, contradictory between the two classes.

High school and college grades as well as results on standardized tests provided little, if any evidence, of an individual’s performance in a group (as opposed to the claim in the previously paper[1] that higher SAT Verbal and Lower SAT Analytical scores seemed to be characteristic of the good team players). Table 6 below summarizes these results.

Sophomore design class (N=126)

temperament	class avg	good player's average	poor player's average
E	64	56	67
S	61	49	62
T	69	66	66
J	81	85	75

Senior capstone design class (N=172)

temperament	class avg	good player's average	poor player's average
E	64	69	55
S	65	66	78
T	76	86	67
J	89	93	95

Table 5: Myers-Briggs Temperament Indicators [3,4] Expressed in Percent

	class avg	good player's avg	poor player's avg
High School gpa (self reported)			
all classes	3.42	3.41	3.46
capstone only	3.48	3.34	3.54
University of Houston gpa (self reported)			
all classes	3.11	3.04	3.03
capstone (only)	3.02	2.98	2.97
SAT Verbal (self reproted)			
all classes	558	536	544
capstone (only)	528	539	520
SAT Analytical (self reported)			
all classes	630	650	645
capstone (only)	644	612	646

Table 6: Grade Point Averages (out of 4.0) and SAT Scores

Table 7 summarizes the students' responses to nine statements. The students were asked to indicate their responses as follows: 5 if they strongly agree, 4 if they agree, 3 if they are neutral, 2 if they disagree and 1 if they strongly disagree. Again the averages for all 298 students and also for the capstone course alone (N=172) are given for each of the two populations and for those characterized as either "good" and "poor" team players.

The response to Statement 1 seems to indicate that interest in the class itself is not an issue. From Statement 2 the “poor” team players seem a little less likely to be enjoying the class than the “good” team players. Interestingly, the “average” team players seem to like to work in groups and like their current groups better than either the “good” or the

	Responses of all	Responses of the "good" team players	Responses of the "poor" team players
1. I was looking forward to taking this class.			
All	3.42	3.41	3.46
Capstone	3.48	3.34	3.54
2. I am enjoying this class.			
All	3.85	3.95	3.46
Capstone	3.81	3.98	3.50
3. I like working in groups.			
All	4.08	4.00	3.83
Capstone	4.14	4.09	3.91
4. I like working in MY group			
All	4.17	3.94	4.08
Capstone	4.17	4.09	4.00
5. I would change groups if I could.			
All	1.97	1.96	2.04
Capstone	2.06	2.04	2.37
6. I think that my group is working efficiently.			
All	3.94	3.82	3.89
Capstone	3.95	3.89	3.77
7. Learning to work in groups is important.			
All	4.67	4.73	4.60
Capstone	4.61	4.69	4.53
8. I have experience working with hand and power tools.			
All	4.03	4.13	3.98
Capstone	3.94	3.91	3.87
9. I have above average drawing skills.			
All	3.39	3.59	3.20
Capstone	3.45	3.53	3.32
10. In the instructor's opinion, "This student has above average drawing skills."			
All	2.71	3.19	2.59
Capstone	2.60	2.93	2.57

Table 7: Student Responses to Nine Statements: 5 = strongly agree; 4 = agree; 3 = neutral; 2 = disagree; and 1 = strongly disagree.

“poor” team players. (About half the class is “good” or “poor” players so, for example, with Statement 4, the “average” player response is about 4.30+ compared to 3.94 and 4.08 for the “good” and “poor” players.) In response to Statements 5 and 6, the “poor” team players seem almost as satisfied with their groups as the others. All recognize the importance of group work (Statement 7) and hands on experiences (Statement 8) seem to have only a marginal effect on team-working abilities. Finally, the effect of drawing skills is considered in Statement 9 in which the students were asked to response to the statement, "I have above average drawing skills. This result is compared with the instructor's response Statement 10, "This student has above average drawing skill," after he had examined a drawing sample submitted with the questionnaire. All students were requested to provide a three-dimensional rendering of a simple shape for which two views were provided.

As reported previously[1] drawing ability seems to be related with group performance. From the instructor's response (Statement 10), it would appear to be more a case that good drawing skills correlate positively with good group skills rather than poor drawing skills correlating positively with poor group skills.

Discussion

Team Players

The determination of "good" and "poor" team players is largely subjective. However, the peer evaluations and a semester long observation by the instructor has removed much of the uncertainty in rank ordering a player's "quality". The cut off points between "good", "average," and "poor" are certainly debatable. Also, the peer evaluations stress "team" support and participation, but not necessarily leadership or academic superiority. The issue of overall group effectiveness is not addressed, and many would argue that this issue is more important than individual performance.

Data Scatter

Whenever averages are computed the issue of the data distribution about the averages arises. Standard deviations were calculated for all the averages (age, work experience, gpas, test scores, and responses to statements). The scatter was large. For example, for the set of the three capstone classes (N=172) the averages (avg) and the standard deviations (σ) are illustrated in Table 8.

item	avg	σ
age (yrs)	25.2	4.5
work exp (yrs)	5.3	4.5
eng'g exp (yrs)	1.7	2.6
HS gpa (out of 4.0)	3.48	0.47
UH gpa (out of 4.0)	3.02	0.43
SAT V	528	106
SAT M	644	85

Table 8: Examples of the Standard Deviations for the Data from the Combined Capstone Classes Sample (N=172)

Standard Deviations were also calculated for the responses to the statements (Table 7), and values ranged from 0.52 (working in groups is important) to 1.01 (I want to change groups). However, the standard deviation is not an appropriate measure of scatter in this discrete response system that is almost always bi-nodal and even tri-nodal.

Deviations from Previous Results

The previous paper, based on only one semester's data (92 students working in 27 teams), presented "preliminary" conclusions that have now been shown to be suspect if not in error. It now appears that hands-on experience, grades and standardized test scores have little influence in predicting teaming skills.

Confirmation of Previous Results

As before the better team players tended to be older, with more general and engineering related work experience. Caucasians and Hispanics continued to perform better than the other ethnic groups (Asian and African American). As noted, the ethnic distribution in the classes was about one-third Caucasian, one-fourth Hispanic and Asian, and one-tenth African American. A better testing situation would be to have had equal distributions. Women still performed better than men but only slightly. Again there appeared to be no relationship between teaming skills and personality temperaments. Students with better drawing skills tended to be better team players. Also, the better team players tended to better self-critics of their drawing skills, but this characteristic was a much weaker predictor than initially claimed.

Conclusions

An earlier study that attempted to identify the desirable characteristics of "good" team players has been continued. Some of the conclusions (which were acknowledged at the time as been "preliminary") of the earlier study seem to have been arrived at prematurely. However, the current study has confirmed the earlier conclusions that older students with more general work, more engineering work experience and better drawing skills seemed to be better candidates for "good" team players. The representatives of the two "major cultures" (Caucasian and Hispanic) were more effective in groups, but it would be premature to conclude that the other cultures are more likely to be "poor" team players until studies using populations with different ethnic distributions are completed. Grade point averages from both high school and college, as well as the results from the SAT Verbal and Analytical Tests, were shown to have little or no value as predictors of teaming skills. Perhaps surprising to some, personality indicators, i.e., MBTI, still seem to have little correlation with individual success in a group. All the students very strongly agreed that working in groups is important and in fact provided similar responses to a variety of statements related to their group work experience. The only major exception was that the "good" team players indicated that they were "enjoying this class" more than the "poor" team players. It was determined that the ability to express oneself through drawing may be a core skill for working successful in a group. Clearly, it is not the drawing skill itself that matters here but perhaps it is the artistic culture at work.

People trained in the arts tend to be more group oriented (easily sharing ideas and willing to participate in group critiques) than the average engineering student who tends to be more solitary and competitive. Finally, the ability to objectively assess ones own artistic skills was seen to be a weak indicator of a "good" team player.

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RICHARD BANNEROT

Richard Bannerot is a Professor of Mechanical Engineering at the University of Houston. His research interests are in the thermal sciences and in engineering design education. For the past thirteen years he has taught the required "Introduction to Design" course at the sophomore level and has recently become involved in the teaching of the college's capstone design course. He is a registered engineer in the state of Texas.