HOW DO INDIVIDUAL PERSONALITY TRAITS OF TEAM MEMBERS CORRELATE WITH OUTCOME OF THE DECISION PROCESS IN COLLABORATIVE ENVIRONMENTS?

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ABSTRACT

In this research, we focused on understanding how the individual personality traits of the team members and the interactions they make influence the decision-making process in a collaborative environment. The foundation of the study is based on Carl Gustav Jung's theory and the Myers-Briggs Type Indicator which converges to form the 16 Personality test and the Interaction Dynamic Notation (IDN) which converges to decision-making visualization in group contexts. We assessed the speaker participation through recordings of group meetings to understand the progress of interactions and obtained data on their personalities through the 16 Personality test. The study carried out pairwise analysis between the various personality traits i.e. Introverted/Extroverted, Observant/Intuitive, Thinking/Feeling, Judging/Prospecting, Assertive /Turbulence, and the speaker dominance. Based on the above comparison, visually, we found that there are some correlations between dominant personality traits and speaker dominance in the decision-making process. The above statements hold true for visualization only we weren't able to show this on paper with proper analysis due to the limited resources we had. Although our research provided insights into the relationships between personality traits, interactions between the team, speaker dominance, and decision-making dynamics, it also highlighted some limitations affecting the conclusion. However, these findings give us room for further explorations into the impacts of individual characteristics on team interactions. From a broader perspective, understanding these dynamics is necessary for optimizing team collaborations and also ensuring effective decision-making processes.

1 LINKAGE TO RELEVANT THEORY AND PRIOR LITERATURE

1.1 Literature Survey

The dynamics of team interactions within engineering design teams have gained interest among researchers. The explorations of visual representations as discussed in the paper by *Sonalkar et al. (2012),* emphasize the way concept generation develops in design teams. These visual methodologies offer a way through which the flow of collaborative tasks can be examined. It also highlights the importance of certain individual inputs in a collaborative environment and how certain unique interactions/characteristics can influence the outcome of the team dynamics/decision-making. [1]

Sonalkar et al. (2017) The study focuses on understanding how individual traits and characteristics influence interactions during the ideation process. Utilizing the Kirton Adaption -Innovation inventory to examine individual preferences and Interaction Dynamics Notation (IDN) for quantitative analysis of team interactions. The study also reveals statistical data on correlations between individual traits and specific interaction behaviours and ideation expressions. This paper also gives us an understanding about the representation of the cognitive behavioural model for a design team performance [2]

The validation and structuring of tools, as reflected in the work by *Foxall et al. (1992),* showcased the effort to measure individual tendencies like adaptivity and innovativeness. Such tools form the backbone of understanding individual contributions in a team setting. It also provides insights on brainstorming, dynamics, design improvisations and analytical metrics to understand team interactions [3]

1.2 Literature Gap

Although the literature provides insights into individual and team dynamics, there are nuanced gaps that our research seeks to bridge:

1. Depth of Correlation: When correlations between personality traits and team behaviours have been established, there is a need to interpret the depth and nature of this relationship to establish if the correlation can be translated to causality.
2. Contextual Efficacy: The effectiveness of certain behaviours in achieving design outcomes might be heavily influenced by the personality styles of a team. We can question how the design methods can be tuned to these personality traits to optimize outcomes.

Our research is grounded in theories like Carl Gustav Jung's and methodologies such as the Myers-Briggs Type Indicator, which are time-tested approaches in the realm of collaborative studies. By investigating the relationship between individual personality traits and team outcomes, our study adds depth to existing knowledge in turn paving new territories to explore. This can revolutionize how teams are formed, how collaborative tasks are approached, and an important aspect of how education can be structured too.

2 METHODS

In this section, we provide a detailed account of the methods employed in our study. We have organized this section into three key subsections: Participants, Data Collection, and Experimental Design.

2.1 Participants

Participants in our study were from diverse backgrounds which supported the scope of this study. The following demographic information was collected to provide a comprehensive overview of the study population:

1. Age – The average age of the participants was 22 years.
2. Gender – The study involved two female participants and one male participant.
3. Educational background - The participants came from different educational backgrounds in mechanical engineering, engineering design, physics, and industrial engineering.
4. One of the participants was not comfortable with sharing their data and hence their data was not collected.

Due to the lack of background data, we have not considered it as a factor in our analysis, although the diverse backgrounds of the participants ensured the generalizability of our findings. The assigned participants of Team 1 will be referred to as the 'team' or 'research participants' throughout this memo.

2.2 Data Collection

Data collection was conducted with meticulous attention to aligning our methods with overarching research objectives. We employed the following strategies to collect data:

1. Decision Making Log: Participants were asked to maintain a decision-making log, recording their thought processes, choices, and rationales throughout the study period. This method was selected to capture real-time decision-making patterns and group perspective on their project, which was crucial for our research objectives.
2. Audio Recordings of Group Meetings: Audio recordings of the group meetings were requested to analyse group dynamics and decision-making processes in a real-world, group setting. These recordings provided valuable qualitative insights, aligning with our research goals.
3. 16 Personalities Test: To assess personality traits relevant to our research, participants were administered a well-established personality test - the 16 Personalities test. The test has a strong foundation in prior literature for its reliability and validity. The test is based on statistical analysis (internal consistency, test-retest reliability, discriminant validity_ incorporated into the system to ensure the output is consistent every time.

The choice of data collection methods was driven by their alignment with prior literature and the need to comprehensively capture the decision-making processes under study.

2.3 Experimental Design

Our study employed a structured experimental design to investigate the correlation between individual personality characteristics and team member interactions. The following aspect of our experimental design is noteworthy: The experiment was conducted in a naturalistic in-situ setting, providing a real-world

context for our research. This choice of setting was informed by the need to capture authentic behaviours and responses.

3 ANALYSIS

For the analysis of the data, various statistical methods were used to identify trends between the various data collected and develop valuable insights. Most of the data collected, i.e. interview recordings and the decision log, were dependent factors that provided qualitative data to represent the engineering design process. This data was converted to quantitative data to allow it to be compared to the personality traits that were measured for the 5 personality traits.

3.1 Explored the variation in the group members' personality traits

The collected personality trait data was presented in comprehensive bar graphs to visually analyse the differences between each member. This allowed the research team to formulate a general idea of the demographics of the research participants. Presenting the bar graphs (Figure 1, see Appendix) allowed the research team to plan the statistical analysis methods for the present problem since there were no previous schema found that aligned with the team's data.

Inspired by the Kitron Adaptation Innovation Personality test [3] which uses the KAI mean scores to evaluate the three sub-factors of the cognitive styles, this study employs the method of extracting standard deviation in the 5 personality trait groups. Although the 16 personality tests do not solely focus on the cognitive styles of each research participant, it is indicative of how the team members relate to their environment, other members, and external factors.

3.2 Development of a visual and statistical notation system for the group interactions

Based on the interaction dynamics notation, speaker dominance was calculated. We went through the team recordings for the four significant group meetings to map out how every individual interacted based on the description of the moves (Figure 3, see Appendix) and the sequence of their interactions. Presenting this in excel allowed us to tabulate the number of times each individual participated during each meeting. This was vital to establish the group dynamics.

Furthermore, a pairwise analysis of the group dominance for each meeting was compared against each member's contributions to every meeting to have a final order of their participation in their design team (Table 2, see Appendix).

3.3 Interaction patterns assessed by visual representation

In addition, through the IDN results, we created pie charts to illustrate the distinct types of contributions made by individuals during the four group meetings (example Figure 4, see Appendix). This representation facilitated the analysis of each member's specific role in the team. This was compared with the member dominance graphs (Figure 5, see Appendix) see that were generated. A basic overlap graph was mapped to detect any correlation between the type of contribution and the speaker dominance patterns.

3.4 Compare the documented evidence with other forms of evidence

The decision log was evaluated manually by accounting for the major decisions made in every group meeting. Every log entry was traced back to the decision from which it originated to finalize the key decisions in every meeting. This created a paper trail for their meetings allowing us to compare their discussions with their perspective of the key takeaways from them. Additionally, we evaluated the wording of the decisions and their final prototype to discern if the decision was directly impacting the final prototype. To present this, we made a table and color-coded the decisions with those that impacted the final decisions in white circles and those that were evaluated and dropped in the upcoming meeting using black circles (Table 1, see Appendix).

4 RESULTS

Based on Figure 2 (see Appendix), the highest deviations were noted in the introverted/extroverted, Judging/Prospecting and Assertive/Turbulence, with standard deviations of 16%, 19% and 17% respectively. These were significant deviations to be considered for further analysis. Based on the researched theory [4], these traits are reflective of how the members interact with their surroundings, how they approach work, planning and decision making, and how confident they are in their abilities. From the average calculation of the

member dominance charts, Member 4 had the highest percentage of dominance followed by varying results for Member 2 and Member 3 which was further confirmed by the pairwise analysis that was carried out (Table 2 and Table 3, see Appendix). Member 1's contribution was consistent throughout the 4 meetings. With no significant variation in the group dominance trends between the four meetings (Figure 5, see Appendix), we explored the interaction types for each member for each of the meetings. Correlating this to their personalities and varying dominance brought about no significant trend.

Meeting 3 had the greatest number of decisions made (Table 1, see Appendix). Even though some of them were not carried forward in the final design, we strongly believe they still impacted the final design as the team employed an AHP (Analytical Hierarchy Process) matrix to confirm their findings. With multiple designs tested against this matrix, it is certain that this strengthened their final design as it was evident that many of the undesirable features were removed early in the design process. Specifically, looking at meeting 3 with the interaction types, there was no visible trend to relate this to their personality traits and the type of moves recorded for every individual in the different meetings (Figure 4, see Appendix).

5 CONCLUSION

There is lack of statistical evidence to support the hypothesis that there might be a correlation between the personality traits of group members and the decisions made. Although we can infer that the varying personality traits of the members in the engineering design group would have positively influenced the final design based on literature review, we cannot be certain of which trait of the members was most influential in the decision-making process. All possible comparisons were made with the data collected throughout the whole engineering design process. This did not yield conclusive correlations between the individual personality traits of team members with the outcome of the decision process in a collaborative environment.

We can suspect that there are various other variables that would directly influence the speaker dominance and decision-making process apart from just individual personality traits. To further explore this topic, a cognitive study can be conducted where data is collected individually from every member at different times of the design-making process. Even though further explorations may indicate a correlation between the member personalities and the decision made, correlation cannot be concluded as causality. Future studies need to account for possible cognitive bias to truly prove this hypotheses.

REFERENCES

[1] N. S. Sonalkar, a. O. (2012). A visual representation to characterize moment to moment concept generation in design teams.

[2] Neeraj Sonalkar, L. L. (2017). Design Whodunit: The Relationship Between Individual Characteristics and Interaction Behaviors in Design Concept Generation.

[3] Gordon R.Foxall, P. M. (1992). The factor structure and construct validity of the Kirton adaption-innovation inventory. Personality and Individual Differences, 967-97

[4] (NERIS Analytics Limited, n.d.) https://www.16personalities.com/

APPENDIX

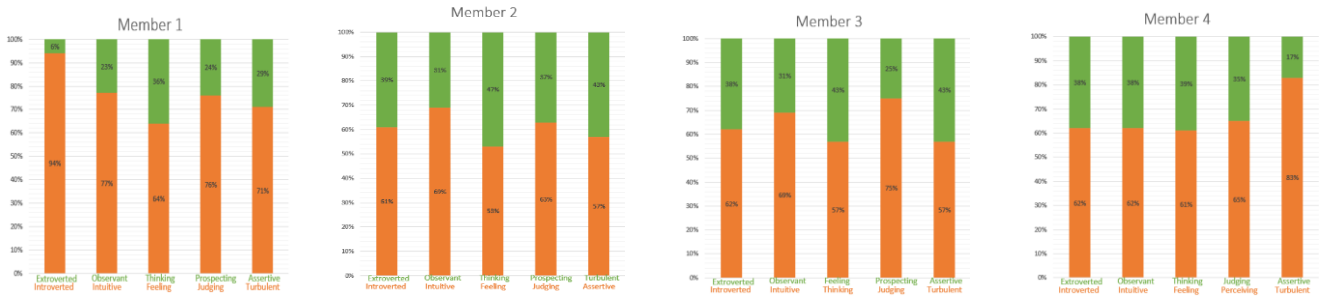

Figure 1: Stacked bar graphs representing the range of each personality trait for the four research participants

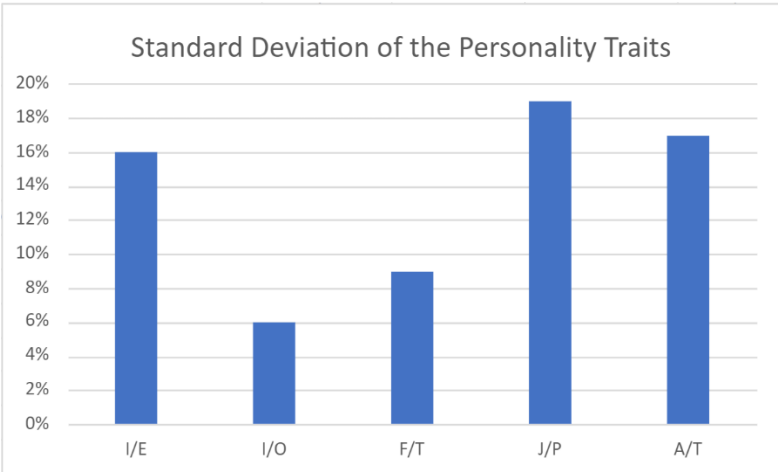

Figure 2: A bar chart representing the standard deviation in personality traits between the 4 members of Team 1

Symbol	Name	Description
A	Move	A 'move' indicates that a speaker has made an expression that moves the interaction forward in a given direction.
? A	Question	A question indicates an expression that elicits a move. A question projects onto the next response and constrains the content of that response because the next response needs to answer the question.
B	Hesitation	Hesitation indicates an expression that is drawn out over time and is not completed. It denotes self-inhibition on part of the speaker.
C	Block	Block indicates an obstruction to the content of the previous move. For a block to be felt, the coder needs to feel that the response in someways obstructed the flow that was established by prior moves.
B	Support for move	Support-for-move indicates that the speaker understands and/or agrees with

Symbol	Name	Description
		the previous move.
C	Support for block	Support indicates an acceptance of a block by another person.
B C	Overcoming	Overcoming a block indicates that though a block was placed in front of a move, a speaker was able to overcome the block and persist on course of the original move.
A B	Deflection	When a speaker blocks a previous speaker's move, that speaker or another can deflect the block with a move that presents an alternative direction for the interaction.
X	Interruption	An interruption is indicative of a speaker being interrupted by another speaker or at times by himself.
C	Yes and	A move is considered to be a 'Yes and' to the previous move if it accepts the content of the previous move and adds on to it.
C	Deviation	Deviation indicates a move that changes the direction of the conversation from the one implied by the previous moves.
A,B	Humor	Humor indicates instances of shared laughter in teams.

Figure 3: Interaction Dynamics Notation Symbols and Description [1]

Figure 4: Distinct types of contributions made by individual group member

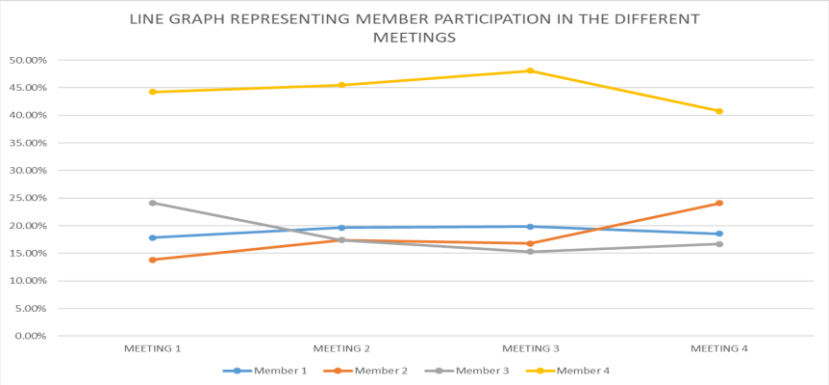

Figure 5: Graph representing Member participation in different meetings

Meeting number	Decisions made
1	○ ○
2	○ ○ ○ ●
3	○ ○ ○
4	○ ○ ○

Table 1: Summary of the decision log

Pairwise Comparison Matrix				
	over A	over B	over C	over D
A wins	--	483	417	0
B wins	108	--	417	0
C wins	174	174	--	0
D wins	591	591	591	--

Table 2: Pairwise comparison matrix results for individuals for the 4 different meetings

Points Tally	
Candiate	Score*
Option A	2
Option B	1
Option C	0
Option D	3

*1 point for a win, 0.5 point for a tie

Table 3: Results of the Pairwise comparison
(Option A is Member 1, Option B is Member 2, Option C is Member 3, Option D is Member 4)