The Joint Effort

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Abstract

This study examined the interplay between extraversion, need for cognitive closure (NCC), and transactional communication (TC) within a collaborative learning environment. The research aimed to determine (a) whether individuals with higher extraversion engage in more transactional communication, (b) whether extraverted individuals exhibit higher levels of NCC, and (c) the extent to which NCC influences transactional communication behaviours. A mixed-methods design was employed, integrating quantitative measures with behavioural observations during a structured problem-solving task using the board game Scotland Yard. Sixteen participants completed the extraversion subscale of the OCEAN survey (Appendix I), and their collaborative interactions were recorded and coded to derive composite scores for TC and for NCC, differentiating between facets reflecting high and low need for closure. Independent t–tests revealed no significant differences between highly extraverted and moderately extraverted participants in terms of transactional communication or NCC levels. However, Pearson correlational analysis indicated that while NCC (high) was not significantly associated with TC, NCC (low) showed a strong positive relationship with TC, $r(12) = .74$, $p < .01$. These findings suggest that cognitive flexibility, indexed by lower need for closure, may play a more critical role in facilitating effective transactional communication during collaborative tasks than extraversion alone. Implications for collaborative learning practices and recommendations for future research are discussed.

Key words: Personality traits, Transactional communication, Need for cognitive closure, collaborative work, mixed methods

Introduction

Collaborative learning has become increasingly emphasized in higher education due to its potential to foster autonomy and enhance learning processes among students (Freeman, 2010; Kirschner et al., 2018). This approach involves students working together to complete specific tasks or solve problems while building on each other's ideas, reaching consensus, and organizing responsibilities effectively (Kirschner et al., 2018; Siahaan et al., 2021). In collaborative learning, four key factors significantly impact team dynamics: the size of the team, the roles learners can or are required to assume, the composition of the group, and the prior experience team members have working together (Siahaan et al., 2021). For example, Zhang et al. (2016) highlight that heterogeneous teams where members bring diverse expertise can especially benefit learners with lower prior knowledge. Conversely, when team members already possess relevant task knowledge, the necessity for intensive transactional communication and coordination diminishes (Kirschner et al., 2018). While the benefits of group work are well documented, individual differences in personality traits, such as extraversion, can significantly influence participation in collaborative tasks. Extraverted students often share ideas readily, lead discussions, and assume active roles, whereas less extravert students may contribute more cautiously or through reflective input (Lambregts, 2020). These differences highlight the importance of understanding and addressing personality-related variations to ensure balanced participation and positive group dynamics. In particular, when highly extraverted individuals dominate the discussion, less extraverted members may face challenges contributing meaningfully, potentially disrupting overall workflow (Lambregts, 2020). Despite extensive research on group-level factors, such as socio-cognitive processes and interdependence in collaborative learning, there remains a gap in understanding how individual characteristics influence collaborative success (Jang et al., 2016). Dillenbourg (1999) provides further insight by outlining social models of co-construction that clarify how knowledge is collectively built in collaborative settings.

According to Dillenbourg, effective collaborative learning is not merely the aggregation of individual contributions, it emerges through dynamic processes such as dialogic co-construction, where meaning is negotiated through interactive dialogue and distributed cognition, where cognitive tasks are shared among group members. These models emphasize that the integration of diverse perspectives is essential for co-constructing knowledge. When dominance by highly extraverted individuals limits balanced participation, the collaborative process can be compromised, resulting in less effective learning outcomes. Thus, incorporating Dillenbourg's models reinforces the need to consider both group-level dynamics and individual personality differences when designing collaborative learning environments. Together, these perspectives underscore that the effectiveness of collaborative learning depends not only on the collective characteristics of the group but also on how individual traits, such as extraversion and introversion, interact during the co-construction of knowledge. Addressing this interplay is crucial for developing educational practices that foster equal participation and enhance learning outcomes.

Extraversion and Introversion

To better understand the nuances of individual contributions to collaborative learning, it is crucial to examine how specific personality traits shape group interactions. Extraversion and introversion are fundamental personality traits that significantly influence individual behaviours within group settings, particularly in collaborative learning environments. Extraversion is characterized by sociability, assertiveness, and a propensity for seeking stimulation through social interactions. Extraverts often exhibit enthusiasm, talkativeness, and a tendency to engage actively in group activities. Conversely, introversion is marked by a preference for solitary activities, introspection, and a lower threshold for external stimulation. Introverts typically display reservedness, thoughtfulness, and a greater inclination towards reflection before action (Flanagan et al., 2019; Westerman et al., 2014). These contrasting

tendencies can lead to imbalances in participation, potentially affecting the dynamics and outcomes of collaborative learning. A study by Jang and Park (2016) examined the association between medical students' personality traits and their collaborative performance during problem-based learning tutorials. The findings suggest that personality characteristics significantly influence students' participation and communication within group settings, thereby affecting the overall success of collaborative learning. This underscores the importance of considering individual personality traits when designing and facilitating group work to optimize collaborative outcomes (Jang et al., 2016).

Need for Cognitive Closure (NCC)

Given that personality traits play a pivotal role in shaping students' participation and communication in group settings, it is essential to explore specific factors that further influence collaborative dynamics. One such factor is the Need for Cognitive Closure (NCC), which impacts how individuals process information, make decisions, and engage in teamwork (Webster et al., 1994). Rooted in Kruglanski's Lay Epistemic Theory, NCC describes an individual's motivation to seek definite answers and minimize uncertainty when acquiring knowledge about the social world. It functions along a continuum, with high NCC individuals favouring structure, predictability, and swift decision-making, whereas low NCC individuals exhibit greater openness to uncertainty, flexible thinking, and prolonged exploration (Kruglanski & Webster, 1996; Calogero et al., n.d). To assess NCC, researchers commonly examine five key dimensions. Preference for Order reflects a desire for structured and organized environments. Preference for Predictability pertains to the need for consistency across situations and an aversion to change. Discomfort with Ambiguity indicates unease in uncertain or unclear circumstances. Closed-mindedness refers to resistance to alternative viewpoints or challenges to one's knowledge. Lastly, Decisiveness denotes a tendency to make quick, firm decisions while avoiding prolonged deliberation (Calogero et al., n.d). In the

context of this study for group work and communication, these facets manifest in specific ways that influence team dynamics. Avoiding ambiguity, closely linked to discomfort with uncertainty, leads individuals to seek clear, definite answers and experience unease in ambiguous discussions. Sticking to one's position, associated with closed-mindedness, results in rigid thinking and resistance to alternative perspectives, potentially limiting the exchange of ideas. Rushing decisions, related to decisiveness, highlights the tendency to prioritize speed over thorough deliberation, which may undermine comprehensive problem-solving. Conversely, patience and exploration, characteristic of low NCC individuals, fosters openness to different perspectives, allowing for deeper analysis and innovation. Similarly, open-ended communication, which aligns with lower NCC levels, supports adaptable discussions and a willingness to engage in ongoing dialogue without the immediate need for closure. Understanding how NCC influences group interactions is essential for fostering effective collaboration, as the interplay between high and low NCC individuals can shape decision-making processes, adaptability, and overall team efficiency. By recognizing these cognitive tendencies, strategies can be developed to balance the need for structure with the benefits of exploratory thinking, ultimately enhancing group cohesion and problem-solving capabilities (Calogero et al., n.d). Former studies have shown that individuals with a higher NCC struggle with uncertainty and experience increased stress in ambiguous situations. For instance, Gärtner and colleagues (2024) found that medical students who scored higher on NCC often associated with introverted tendencies, felt significantly more uncertain about diagnostic decisions. This predisposition is particularly impactful in collaborative work, where inherent ambiguity and a preference for quick resolutions can impede effective group dynamics and problem-solving. In contrast, extraverts, who typically exhibit a lower need for cognitive closure and are more open and communicative, tend to lead information exchange and adaptability within teams. Thus, the interplay between varying levels of NCC and introversion

and extraversion is crucial for understanding and enhancing collaborative efficiency (Gärtner et al., 2024).

Transactional Communication (TC)

A related aspect is transactional communication (TC). Transactional communication (TC) plays an essential role in the success of collaborative learning by ensuring effective information exchange and joint meaning-making among group members. This communication process is characterized by dynamic, reciprocal interactions, where participants actively construct meaning together by building on, critiquing, or enhancing each other's contributions (Siahaan & Sihotang, 2021; Teasley, 1997; Van Dijk et al., 2014). TC involves behaviours such as offering solutions, proposing strategies, and speaking up during decision-making, which are crucial for resolving task ambiguity and achieving common goals (Kirschner et al., 2018). Transactional communication, as described by Siahaan and Sihotang (2021), refers to a dynamic process in which both the sender and receiver actively encode and decode messages simultaneously. This model emphasizes that communication is not a one-way transfer of information but rather a continuous, interactive negotiation of meaning, where feedback plays a vital role in clarifying and confirming the transmitted message (Siahaan & Sihotang, 2021). In this framework, effective communication depends on a shared field of experience between communicators, which enhances the likelihood of accurate interpretation (Schramm, 1954). This is particularly important in collaborative work, where mutual understanding and coordinated action are essential for success (Van Dijk et al., 2014). For example, during a team meeting, members continuously exchange ideas and adjust their contributions based on immediate verbal and nonverbal feedback, ensuring that the group remains aligned with its objectives. Such an environment not only minimizes misunderstandings but also fosters a culture of open, reciprocal dialogue, ultimately contributing to more effective collaboration (Siahaan & Sihotang, 2021). A study by McKay and colleagues (2024) emphasizes the

importance of equal participation in collaborative group work. Students expressed frustration when they felt the distribution of work was not shared equitably, highlighting the crucial role of open communication and regular feedback to prevent frustration and ensure a smooth workflow. Interaction and shared decision-making are key in strengthening group cohesion, skills that tend to be more evident in extraverted individuals compared to introverted ones (McKay et al., 2024).

Aim of the Study

Despite extensive research on group-level dynamics, the role of individual personality differences, particularly how extraverted dominance may hinder balanced participation, remains underexplored. This study aims to fill this gap by examining the interplay between extraversion, NCC, and transactional communication in collaborative learning environments. The present study aims to address this gap by exploring the relationships between extraversion, introversion, NCC, and TC in a controlled collaborative learning environment. Specifically, the study seeks to answer the following research questions:

RQ1: To what extent do more extravert students take part in transactional communication in collaborative work with the presence of higher extroverted colleague in a controlled environment?

H1: People who score higher on extraversion will show more transactive behaviors than people who score lower on extraversion

RQ2: To what extent does the personality trait of being extravert influence participants in a collaborative learning setting in a controlled environment?

H2: Extravert individuals have a higher level of NCC

RQ3: To what extent does need for cognitive closure (NCC) influence transactional communication (TC) in a collaborative learning setting in a controlled environment?

H3: The level of Need for Cognitive Closure (NCC) significantly affects the frequency of transactional communication (TC) behaviours in collaborative learning tasks within a controlled environment.

Methodology

Design

This study employed a mixed-methods approach to gather both quantitative and qualitative data, allowing for a comprehensive examination of how different personality traits interact in collaborative group work. By combining structured measurements with observational insights, this approach provided a deeper understanding of the relationship between extraversion/introversion, transactional communication (TC), and the need for cognitive closure (NCC).

For the quantitative component, a deductive approach was applied, as the study aimed to test existing theories on personality traits and their influence on communication behaviour. The OCEAN survey by McCrae et al. (2004) was used to assess extraversion and introversion, treating this trait as an independent variable. Only the extraversion/introversion subscale was included, and participants completed a 10-item Likert-scale questionnaire (0 = never, 1 = sometimes, 2 = often, 3 = very often).

For the qualitative component, an inductive approach was taken to explore how transactional communication and need for cognitive closure manifest in real-time collaboration. A group experiment was conducted in a controlled environment, where participants played the board game Scotland Yard. Their interactions were recorded and analysed to observe behavioural patterns related to TC and NCC (Webster et al., 1994; Kirschner et al., 2018). This allowed for the identification of emergent communication strategies and decision-making tendencies, without imposing predefined categories.

Participants

A combination of convenience and snowball sampling was used to recruit students from the University of Twente who possessed sufficient English proficiency. Recruitment occurred via networks such as sports teams and personal contacts, with participants also encouraged to refer others. Initially, 16 participants took part in the study; however, data from 2 participants were excluded due to incompleteness, resulting in a final sample of 14 participants. The final sample had a mean age of 26.57 years (range = 19–34 years) and was composed of 3 females and 11 males. Regarding nationality, 9 participants were German and 5 were Dutch. All participants engaged in the same gameplay under standardized conditions, and group sizes varied based on availability, ranging from 2 to 6 participants.

Materials

The OCEAN survey (McCrae et al., 1992) was administered using a 10-item Likert scale, ranging from 0 (never) to 3 (very often). For the purpose of the study, the subscale of extraversion were administered consisting the following items: 1. I see myself as someone who like to talk, express his opinion. 2. I see myself as someone who is reserved or shy, has difficulty approaching others. 3. I see myself as someone who is full of energy, likes to always be active. 4. I see myself as someone who is a leader, capable of convincing others. 5. I see myself as someone who is rather quiet, does not talk a lot. 6. I see myself as someone who shows self-confidence, is able to assert himself. 7. I see myself as someone who is timid, shy. 8. I see myself as someone who is extraverted, sociable. 9. I see myself as someone who likes exciting activities, which provide thrills. 10. I see myself as someone who has a tendency to laugh and have fun easily. For each participant, an overall extraversion score was computed as the average of the responses to these 10 items, resulting in a continuous score ranging from 0 to 3. Based on these average scores, participants were categorized into four groups. Highly Introverted: 0.00–0.75; Moderately Introverted**:** 0.76–1.50; Moderately Extraverted**:** 1.51–

2.25; Highly Extraverted**:** 2.26–3.00. The internal consistency of the extraversion subscale was evaluated using Cronbach's alpha, which yielded an acceptable reliability coefficient (α = .74).

Moreover, the Scotland Yard board game was used as a structured problem-solving scenario to observe participants' interaction styles, decision-making processes, and communication behaviours in a collaborative setting. This game was chosen because it requires teamwork and communication, making it a suitable context for assessing both Transactional Communication (TC) and Need for Cognitive Closure (NCC) in collaborative work. During gameplay, participants worked together to track down the "Mister X" player, requiring them to exchange information, come up with strategies, and make joint decisions. Additionally, R-studio was used for working, cleaning and visualizing the data.

Procedure

Participants first received a QR code linking to the informed consent form, demographic questionnaire, and OCEAN survey to assess their extraversion/introversion levels. They were required to generate a personal code to ensure confidentiality while still allowing researchers to link their survey responses to their observed behaviour in the game session. The game session was recorded to facilitate later behavioural analysis. To minimize observer effects, participants were not fully informed about the specific aspects of their behaviour being observed. However, they were aware that their participation involved a game-based task, and the full scope of the study was disclosed in a debriefing session afterward. To maintain the natural problem-solving dynamics, the game was not introduced beforehand, requiring participants to self-organize and explore the rules independently. Researchers did not provide explanations or problem-related assistance, though participants were allowed to use cell phones for translation or clarification purposes. The study utilized the Scotland Yard board game, a strategy-based problem-solving task where players take on distinct roles. One participant assumes the role of Mr. X, whose location remains hidden,

while the remaining players form the Scotland Yard team, working collaboratively to track and capture Mr. X within 13 rounds. The team may choose to strategize collectively or work independently, offering insight into transactional communication (TC) and decision-making behaviours. Each session lasted approximately 45 minutes and concluded when either Mr. X was caught, which happened when a team member hit the same spot as Mr. X, or the rounds expired without capture and Mr. X win. After the game, recordings were stopped, and participants were fully debriefed on the study's purpose. No rewards were provided for participation. The study was approved by the ethical committee of the University of Twente.

Data analysis

Qualitative analysis

A deductive thematic analysis was conducted to extract themes from the recorded game sessions, as presented in Table 1. A selective coding process was applied to identify key patterns in communication and behaviour related to Transactional Communication (TC) and Need for Cognitive Closure (NCC) in collaborative group work. Observed behaviours were systematically categorized: those reflecting high NCC were characterized by a strong preference for clarity, structure, and rapid decision-making, whereas behaviours indicative of low NCC exhibited openness to ambiguity and a willingness to explore multiple solutions. Codes were reviewed multiple times to ensure their validity and consistency.

Table 1 Coding Scheme

Overview of TC and NCC Coding

Category	Description	Example
Transactional communication		
Propose solution	Speak up and offer a solution	Actually, you can go either this direction or this direction, and I am here, so if he comes, we might catch him
Propose strategy	Speak up and offer a strategy	I will secure this zone alright, and you watch this area
Decision making / speak up	Speak up in a meaningful way contributing to the common goal	Yes, but you are here, and this is my area, and this is his
Need for cognitive closure (high)		
Avoid ambiguity	Ask question(s) for reassurance	So, bobby is just an additional ticket?
Stick to position	An already made decision stays although others try to challenge it	Yes, but that's my opinion
Rush decision	Interrupt, impulsive, coming up with a solution without thinking	Let's all start with the same play stone
NCC (low)		
Patience & exploration	Willing to go into discussion, explain, explore together	Here, the player doesn't move and can only take this line, and when I want to

Open ended communication	Willing to leave a conversation open, leave space for unclarity	move, I could use a taxi, I will figure that out for you I mean, I don't see the reason in this […]

Quantitative analysis

The quantitative part of the study employed the Extraversion subscale of the OCEAN survey (McCrae et al., 2004) to assess participants' levels of extraversion. This subscale consists of 10 items, with items designed to capture introversion (specifically items 2, 5, and 7) reverse scored so that higher scores uniformly indicate greater extraversion. Internal consistency was examined using Cronbach's alpha, which yielded a value of .74, suggesting acceptable reliability. The overall mean extraversion score for the sample was 1.71 (SD = 3.90). The participant sample comprised 14 individuals (11 male and 3 female) aged between 22 and 34 years. Data collection was conducted using Qualtrics; participants accessed the survey via a QR code, enabling automated submission of their responses. Subsequent data processing and analysis were carried out in R-Studio, which was also used to generate descriptive statistics and visual representations to support the inferential analyses.

Normality

Before conducting inferential statistics, the distribution of the key variables Transactional Communication (TC), NCC (high), and NCC (low) was evaluated by using the Shapiro–Wilk test. The results indicated that the data for all variables were normally distributed. TC yielded $W = 0.97$, $p = .45$; NCC (high) yielded $W = 0.95$, $p = .32$; and NCC (low) yielded $W = 0.96$, $p = .38$. Because all p–values exceeded the .05 threshold, the assumption of normality was considered satisfied, and parametric tests were considered appropriate for the subsequent analyses.

Results

Recruitment for the study took place at the University of Twente between October and November 2024 using a combination of convenience and snowball sampling. Initially, 16 participants were recruited. However, 2 participants were excluded from the final analysis due to incomplete survey responses, resulting in a final sample of 14 participants (*N*=14), (11 male, 3 female).

Missing Data

Of the 16 participants initially recruited, 2 were excluded because of incomplete data on key survey items. No imputation methods were applied, only complete cases were included in the subsequent analyses.

Descriptive Statistics

Table 2

Group Mean and Standard Deviation M(SD)

Group	Transactional Communication	NCC (high)	NCC (low)	Age
Highly extravert (n=7)	3.52 (1.26)	1.48 (0.57)	1.17 (1.61)	26.3 (3.73)
Moderate extravert (n=7)	4.57 (3.70)	2.10 (1.98)	2.29 (2.34)	26.9 (4.34)

RQ1: To what extent do more extravert students take part in transactional communication in collaborative work?

H1: People who score higher on extraversion will show more transactive behaviours than people who score lower on extraversion.

A t–test was conducted comparing TC scores between extraverts ($M = 3.52$, $SD = 1.26$) and moderate extraverts ($M = 4.57$, $SD = 3.68$). The analysis did not reveal a statistically

significant difference between the two groups, $t(12) = 0.71$ $p = .49$, 95% *CI* [–1.20, 2.30]. The effect size was small (Cohen's $d = 0.27$). Therefore, the hypothesis can be rejected.

RQ2: To what extent does the personality trait of being extravert influence participants in a collaborative learning setting?

H2: Extravert individuals have a higher level of need for cognitive closure (NCC).

Separate t–tests were conducted for both measures of NCC. For NCC (high), high extraverts had a mean score of 1.48 ($SD = 0.57$) while moderate extraverts had a mean score of 2.10 ($SD = 1.98$). The difference between those groups was not statistically significant, $t(12) = 0.80$, $p = .44$, 95% *CI* [–0.50, 1.74], with a small effect size ($d = 0.32$). Similarly, for NCC (low), extraverts had a mean score of 1.71 ($SD = 1.61$) compared to 2.29 ($SD = 2.34$) for moderate extraverts; this difference also failed to reach significance, $t(12) = 0.53$, $p = .60$, 95% *CI* [–0.98, 1.31], Cohen's $d = 0.21$.Thus, the data do not support the hypothesis that extravert individuals exhibit a higher level of NCC and the hypothesis can be rejected.

RQ3: To what extent does need for cognitive closure (NCC) influence transactional communication in a collaborative learning setting?

H3: The level of need for cognitive closure significantly affects the frequency of transactional communication behaviours.

To examine the relationship between NCC and TC, Pearson correlations were computed across all 14 participants. For NCC (high), the correlation with TC was $r\ (12) = 0.53$, $p = .60$, 95% *CI* [–0.98, 1.31], Cohen's $d = 0.21$. which was not statistically significant. In contrast, for NCC (low), a strong positive correlation emerged, $r(12) = 0.74$ $p < .01$, 95% *CI* [0.34, 0.92]. These results suggest that while the NCC (high) measure was not significantly related to transactional communication, the NCC (low) measure was significantly and positively associated with TC. In other words, higher scores on NCC (low) were linked to

increased transactional communication behaviour and thus the hypothesis is true and can be retained.

Discussion

The present study explored how extraversion and need for cognitive closure (NCC) influence transactional communication (TC) in a controlled collaborative learning environment. Three research questions were addressed. First, the study examined whether individuals scoring higher on extraversion exhibit more transactional communication behaviours (RQ1/H1). Second, it investigated whether extraverted individuals display higher levels of NCC (RQ2/H2). Third, the relationship between NCC and transactional communication was assessed (RQ3/H3). Overall, the findings provide a nuanced view of how personality traits and levels of need for closure combine to shape collaborative communication

Summary of Findings

With respect to transactional communication, an independent–samples t–test comparing highly extraverted (M = 3.52, SD = 1.26) and moderate extraverted participants (M = 4.57, SD = 3.68) revealed no statistically significant difference, $t(12) = 0.71$, $p = .49$. This result led to the rejection of H1, which predicted that higher extraversion would be associated with greater transactional communication. Similarly, separate t–tests for NCC (high) and NCC (low) yielded non-significant differences between personality groups (NCC high: $t(12) = 0.80$, $p = .44$; NCC low, $t(12) = 0.53$, $p = .60$), providing no support for H2. In contrast, the correlational analyses examining the influence of NCC on transactional communication (H3) produced divergent findings: while NCC (high) showed a moderate, non–significant negative relationship with TC, $r(12) = –0.31$, $p = .25$, NCC (low) was strongly and positively correlated with TC, $r(12) = 0.74$, $p < .01$. These findings suggest that aspects of NCC related to patience,

exploration, and open–ended communication are significantly associated with increased transactional communication behaviours.

Relation to the Literature and Hypotheses

The lack of a significant difference in TC between highly extraverted and moderate extraverted participants is somewhat unexpected given previous research suggesting that extraversion is linked to greater participation in group interactions (Jang et al., 2016; McKay et al., 2024). It is possible that the controlled setting and the specific task demands of the board game moderated the expected influence of extraversion on communication. Alternatively, the numerical trend showing moderate extraverts with a higher mean TC might indicate that in certain collaborative contexts, a moderate level of extraversion facilitates adaptability and balanced participation, rather than the more assertive behaviours typically associated with high extraversion. Similarly, the anticipated relationship between extraversion and NCC (H2) was not supported. This finding is consistent with studies suggesting that the link between personality and cognitive level factors is complex and may be influenced by situational as well as dispositional variables (Kruglanski & Webster, 1996; Calogero et al., n.d). Notably, the strong positive association between NCC (low) and TC supports H3 and aligns with theoretical perspectives positing that individuals with lower need for cognitive closure who exhibit greater openness to ambiguity and a willingness to explore multiple solutions are better able to engage in dynamic, reciprocal communication (Webster et al., 1994). In this study, participants with higher NCC (low) scores were significantly more likely to contribute ideas and engage in collaborative problem-solving, highlighting the importance of cognitive flexibility in group settings.

Interpretation and Explanation

The current findings underscore that while extraversion may not directly predict transactional communication behaviours in this sample, cognitive factors, particularly those

reflected in NCC (low), play a crucial role. One interpretation is that transactional communication in collaborative tasks relies less on general sociability and more on a willingness to tolerate uncertainty and explore multiple perspectives. This could explain why participants who scored lower on NCC as for example exhibited greater patience and open–ended communication, engaged more actively in the collaborative process. In contrast, high NCC which emphasizes decisiveness and a desire for closure, may curtail the iterative, exploratory discussions that characterize effective group work.

Limitations

Several limitations of this study should be acknowledged. First, the relatively small sample size (n = 14) reduces statistical power, increasing the risk of Type II errors, and limits the generalizability of the findings to a broader population. Second, the absence of participants with distinctly introverted profiles constrains the ability to examine the full spectrum of personality influences on communication. This limitation reduces the opportunity to compare the extremes of extraversion and introversion, which is important for understanding how varying levels of these traits affect collaborative interactions. Third, by focusing exclusively on extraversion as measured by the OCEAN survey, the study does not incorporate other personality dimensions, such as agreeableness, conscientiousness, neuroticism, and openness, that may also influence collaborative dynamics. Fourth, while the controlled board game setting provided a standardized task for observing collaborative behaviours, it may not fully capture the complexity and spontaneity of real-world collaborative learning environments, thereby limiting ecological validity. Finally, time constraints and the use of convenience sampling may have introduced bias, as the non-random selection of participants limits the representativeness of the sample. Additionally, reliance on self-report measures for extraversion may have introduced biases such as social desirability. Although the qualitative coding was reviewed multiple times to ensure validity and

consistency, the inherent subjectivity in qualitative data analysis may affect the reliability of the findings. Future research should aim to address these limitations by increasing sample size, incorporating a broader range of personality measures, and utilizing more naturalistic collaborative settings.

Directions for Future Research

Future studies should endeavour to include larger and more diverse samples, particularly incorporating individuals with a wider range of personality traits, including more introverts. Expanding the investigation to consider additional personality dimensions and contextual variables such as group size or task complexity could yield a more comprehensive understanding of the interplay between personality and collaborative communication. Longitudinal research examining these relationships over time and across varying collaborative settings would further clarify the dynamics observed in this study. Moreover, experimental interventions designed to foster cognitive flexibility and reduce the need for closure may help elucidate causal relationships and inform pedagogical strategies.

Practical Implications

Despite the limitations, the present study offers valuable insights for educators and practitioners in higher education. The strong positive association between NCC (low) and transactional communication suggests that promoting an environment that values openness, exploration, and tolerance for ambiguity may enhance collaborative learning outcomes. Educators might consider incorporating activities that encourage dialogue and the sharing of diverse perspectives, as well as providing feedback that reinforces exploratory communication behaviours. Such strategies could help mitigate potential imbalances in group participation and foster a more inclusive and effective learning environment.

Conclusion

In summary, while extraversion alone did not predict transactional communication and extraverted individuals did not exhibit higher levels of need for cognitive closure, the findings highlight the critical role of cognitive flexibility in collaborative settings. Specifically, individuals with lower need for closure were more actively engaged in transactional communication. These results contribute to a growing body of literature on the interplay between personality and cognitive factors in group work, offering practical insights for enhancing collaborative learning experiences.

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Appendix

During the preparation of this work the author used chatGPT in order to assist with grammar and spelling and to debug code for R-studio. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the work."

Appendix I

Ocean Survey Answer each Question from a Scale to 0-3 (0=never, 3=very often)

I see myself as someone who...

	0	1	2	3
Like to talk, express his/her opinion.	○	○	○	○
Is reserved or shy, has difficulty approaching others.	○	○	○	○
Is full of energy, likes to always be active.	○	○	○	○
Is a leader, capable of convincing others.	○	○	○	○
Is rather quiet, does not talk a lot.	○	○	○	○
Shows self-confidence, is able to assert himself/herself.	○	○	○	○
Is timid, shy.	○	○	○	○
Is extraverted, sociable.	○	○	○	○
Likes exciting activities, which provide thrills.	○	○	○	○
Has a tendency to laugh and have fun easily.	○	○	○	○