3-2023

The role of argumentation on high- and low-creative performing groups: A structuration analysis of undergraduate students' group discussion

Ingrid P. HERNANDEZ SIBO
National Cheng Kung University

David A. GOMEZ CELIS
National Cheng Kung University

Shyhnan LIOU
National Cheng Kung University

Brandon KOH
Singapore Management University, brandonkoh@smu.edu.sg

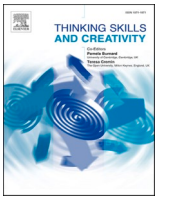
Angela K. Y. LEUNG
Singapore Management University, angelaleung@smu.edu.sg

Thinking Skills and Creativity 47 (2023) 101217

Contents lists available at ScienceDirect

Thinking Skills and Creativity

journal homepage: www.elsevier.com/locate/tsc



The role of argumentation on high- and low-creative performing groups: A structuration analysis of undergraduate students' group discussion

Ingrid P. Hernandez Sibo [a,*], David A. Gomez Celis [a], Shyhnan Liou [a], Brandon Koh [b], Angela K.Y. Leung [b]

[a] Institute of Creative Industries Design, National Cheng Kung University, Tainan, Taiwan
[b] Singapore University of Social Sciences

ARTICLE INFO

Keywords:
Structuration Theory
Group Creativity
Group Communication
Argument
Lag Sequential Analysis

ABSTRACT

Communication is essential for group creativity, and involves cognitive and social processes. However, research rarely investigates how these two processes unfold from a communication perspective, and its consequences on group creative performance. This study adopted the structuration theory as a framework that is capable of integrating both approaches in the study of in-group communication. In particular, we employed a structuration view to examine group argument; a social practice defined as both a system (argumentative patterns of interactive behaviors) and a structure (rules and resources undergirding the system). By applying the Conversational Argument Coding Scheme (CACS) and Lag Sequential Analysis (LSA) to analyze the argumentative behaviors of 17 groups of undergraduate students performing a creative task, we identified significant differences in the systems and structures exhibited by high and low-performing groups. Successful creative groups exhibit argumentative patterns characterized by conflict, which contributes to the generation of new ideas and the integration of diverse perspectives. In contrast, less successful groups revealed a system that focused on reaching consensus rather than challenging or evaluating ideas. This paper further discusses the first empirical evidence provided by LSA on unpacking the communication dynamics that involve social and cognitive processes in in-group creative discussions.

1. Introduction

Creativity is a fundamental skill to support nations for the achievement of higher employment rates, economic success (Burnard, 2006; Davies, 2004), and to endure the increase competition of the contemporary economy. Therefore, several countries, have included creativity at various educational levels as a fundamental life skill (Shaheen, 2010) to thrive in the 21st Century. Developing the creative skills of individuals is relevant for education as it is the cornerstone for building the human capital of nations.

Working in groups is a norm in modern organizations for the development of creative solutions to contemporary challenges, yet the

* Corresponding author at: Institute Of Creative Industries Design, National Cheng Kung University Institute of Creative Industries Design, No.1, University Road, Tainan City 701, Taiwan.

E-mail addresses: pa8067051@ncku.edu.tw (I.P. Hernandez Sibo), ra8067037@ncku.edu.tw (D.A. Gomez Celis), shyhnan@mail.ncku.edu.tw (S. Liou), brandonkoh@smu.edu.sg (B. Koh), angelaleung@smu.edu.sg (A.K.Y. Leung).

https://doi.org/10.1016/j.tsc.2022.101217
Received 6 September 2022; Received in revised form 4 December 2022; Accepted 8 December 2022
Available online 10 December 2022
1871-1871/

challenges of working effectively in groups are considerable. Although scholars have provided evidence about elements that enhance or mar individuals' creativity, knowledge about what promotes or impedes groups' creative performance is scarce. Creative performance is conceptualized as the generation of problem solutions, insights, and ideas that are both novel and useful (De Dreu et al., 2012). Although individuals have the potential for being creative, a group's creative performance does not occur spontaneously. The core product of a group originates from the integration of individuals' perspectives into a unique understanding, only possible through interaction between different knowledge and experiences. Then, communication is the foundation of any group creative activity.

In group creativity, communication is an essential social process that can affect cognitive processes and the creative outcome (Calhoun, 1993; Kauffeld & Lehmann-Willenbrock, 2012; Kratzer et al., 2004; Lovelace et al., 2001; Reiter-Palmon & Sands, 2015). The communication process allows group members to cohere and coordinate their efforts. It is essential to create the necessary social environment to stimulate and exploit the creative potential of the group. When working in groups, individuals do not have any alternative but to communicate. In essence, communication in creative groups encompasses both individual cognition and social level processes. Substantial research on group creativity has independently distinguished these two perspectives to explain the creative process. The cognitive approach emphasizes that individuals generate ideas through retrieval and association of existing knowledge in response to the immediate environment or problem (Brown et al., 1998; Nijstad & Stroebe, 2006; Paulus & Brown, 2007). In contrast, the social interaction approach focuses upon the on-going interactions within the group as the source of creative ideas (Kratzer et al., 2004; Paulus et al., 2019; Sonnenburg, 2004). Although there have been effort to integrate the two perspectives to provide a holistic understanding of the group creative process (Harvey, 2014; Paulus & Brown, 2007), the existing frameworks do not sufficiently account for the value of communication processes. To fill this gap, this study draws upon structuration theory. Considered one of the most influential theories in group communication, structuration theory integrates individual and social perspectives within a single framework to explain group outcomes (Cragan & Wright, 1990).

From a structuration perspective, group creativity is a social activity constituted by the production and reproduction of ideas. That is to say, individuals bring ideas into the discussion and constantly recreate them through social interaction. Argumentation is a social process used by individuals to justify their own views and persuade others to agree (Jehn & Mannix, 2001). Then, group members use arguments as a communicative mechanism to propose, develop, accept or reject ideas during a collaborative problem solving activity. According to the structuration view, the conception of argument refers to both structure, the rules and resources that guide individuals to produce an argument, and system, the observable communicative pattern behaviors in which structure is involved (Meyers et al., 1991). To illustrate the concepts of argument-as-structure, and argument-as-system, consider the situation in which a group discuss to solve a task. At first, structuration analysis reveal the argument-as-system that emerge in member's interaction. For example, it could be directly observed from the content of their discussions that members constantly disagree, question or challenge other's ideas. In addition, members may offer explanations and justifications to respond when their ideas are challenged. Then, a deeper level analysis of argument-as-structure explains why the system unfolds as it does by revealing the tacit rules and resources group members used. For example, as the discussion unfolds individuals may share collective rules about how to carry out argumentation interactively. Argument-as-structure occurs through acceptable reasoning and interaction norms, opportunities enabling the exercise of power (this modality is related to the status that the arguer holds), and interpretative schemes for sense making. Conducting such structuration analysis of group argument during the creative process contributes to a more complete explanation of the communication process and its impact on group creative performance. In addition, it can provide useful evidence for educators about promoting certain argument systems and structures to guide groups into an effective creative discussion. Therefore, this study aims to answer the following research questions: (1) what is the system (patterns of interactive argument) exhibited by high and low creative performing groups? (2) What is the structure (rules and resources) that undergird argumentative interactions among high and low creative performing groups?

1.1. Structuration perspective on group creativity

Giddens (1984) established Structuration theory to provide an explanation about the relationship between individual agents and the society. Structuration theory state that society and individuals integrate a fundamental duality, in opposition to the traditional theories that considered social phenomena as determined by social structures, or by autonomous agents. In other words, social phenomena are determined by both structure and agency. That is to say, individuals' actions reflect the influence of social structures and at the same time, these actions allow the production and reproduction of structures. From a structuration perspective, structures are rules and resources, organized as properties of social systems that are continuously created through the flow of social interactions, and actions are social systems reproduced by the continuous interaction of individuals and the structures in which they are implicated.

The sociological foundation of the theory of structuration (Giddens, 1984) is appropriate to the study of group creativity. Creativity is a social activity that results from the interplay of multiple interrelated factors. Social structural factors (i.e., institutions, cultural formations, networks and groups of people) working in the creative process potentially facilitate or constrain the production of creative ideas (Burns et al., 2015). Even creative individuals must interact with social institutions and culture to engage in an individual creative process as they provide symbols, concepts, resources, established rules and norms, and creativity and production strategies. Moreover, the structuration perspective promotes interaction as the epicenter of social practices (i.e., group decision-making, and group creativity), and it perceives them as produced and reproduced in interaction. According to Hargadon and Bechky (2006) interaction appears as the process of interpersonal communication that produces new interpretations and discoveries that lead to creativity. Groups of people working together generate practices and opportunities of interaction aiming to produce new and useful ideas, products, and processes (Drazin et al., 1999; Getz & Lubart, 2009; Woodman et al., 1993).

While creativity is a social activity, it also necessarily requires individual cognition. According to cognitive perspectives of creativity (1) idea generation requires the retrieval of existing knowledge from long-term memory; (2) the generation of creative ideas is

the product of cognitive systems responding to and integrating information relevant to specific situations; (3) the information and knowledge that individuals need to create ideas must be available in memory. Importantly, if that information is not easily accessible, individuals appeal to social interaction to spark the generation of new ideas (Nijstad & Stroebe, 2006; Paulus & Brown, 2007).

The social interaction perspective focuses upon the production of breakthrough ideas in interaction. It considers social interaction as an emergent rather than fixed and stable phenomenon, and emphasizes upon interaction's importance for the realization of outstanding results of creative groups. The discussion of opinions and ideas is fundamental to understand collective processes, because it unveils how actors engage with one another and changes their understanding about reality to develop new ideas. Creative synthesis - the reconciliation of competing views - emerges from contradictions that arise from individuals' interpretations of different situations during the interaction process as a driver of novelty (Seo & Creed, 2002). Individual's understanding of specific situations ignites social interaction, influences ways of thinking, and the questions and social rules that are acceptable and/or desirable. Acknowledging creativity as a social activity where interaction is the main process that individuals use to express their preferences, or state arguments to seek assent or dissent for given proposals, implies to examine different communicative behaviors through which ideas emerge, develop, and are selected.

1.2. Structuration argument perspective on group creativity

Seibold et al. (1981) built the structuration view on group argument upon the analysis of Toulmin (1958), Perelman and Olbrechts-Tyteca (1969), and Jackson and Jacobs (1980). The analysis of these three theories led to the conceptualization of argument as both system and structure (see Fig. 1). As system, arguments refer to the observable argumentative patterns that emerge in member's interaction (e.g. the convergence-seeking pattern described by Perelman & Olbrechts-Tyteca, and the sequence of argument/response showed by Jackson & Jacobs). As structure, arguments are the rules and resources group members use to produce and maintain an argument (e.g., the use of canons of logic in the Toulmin model). This argument conceptualization implies that systems and structures are not independent and therefore both elements should be analyzed in conjunction to accomplish a complete explanation of group argument.

Argument-as-structure and argument-as-system have not been directly explored yet to study communication among creative groups. Harvey and Kou (2013) implicitly invoke the basic elements that constitute the system of arguments (i.e., disagreements, challenges, reasoning, and consensus), and the structure by suggesting that the ultimate goal of group interaction is to integrate members' interpretations (i.e., achieve a shared understanding of the problem framework). Their findings revealed four modes of creative interactions: Brainstorming mode characterized by the generation of unrelated ideas. In this mode, challenges are raised in the beginning of the interaction but are not addressed by the group members leading to an absence of ideas' elaboration or reasoning. Sequential mode refers to the generation and elaboration of a single idea at a time, seeking consensus around each idea was the most prominent feature in this pattern of interaction. In parallel mode, the simultaneous discussion and comparison of several ideas yields to task conflict between members due to their constant disagreements. As a result, a higher number of ideas were generated in this type of interaction. Finally, in the interactive mode, members move back and forth between ideas. A single idea was initially discussed, then interrupted by the discussion of another idea and later brought back again into the conversation. This type of interaction facilitated the

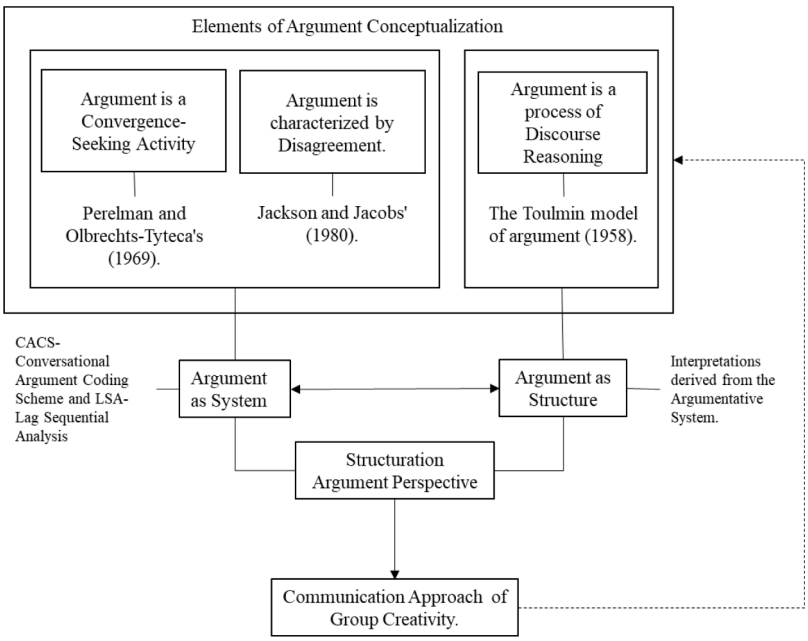


Fig. 1. Structuration Argument Perspective on Group Creativity.

integration of ideas; however, disagreements emerged from the elaboration of a single idea but not from the integration of multiple ideas. It is possible to infer from Harvey and Kou (2013) the strong link that may exist between argument and outcome since each of these modes resulted in more or less conducive interaction processes for creativity.

In this study, the structuration theory grounded Conversational Argument Coding Scheme (CACS) (Seibold & Weger, 2017) is used to code the discussion content of groups working on a creative task. The CACS consists of four different types of argument-relevant categories (see Table 1). (1) Arguables, communicative acts that represent a potential to start or develop a discussion. (2) Convergence-seeking activities, seeks to demonstrate agreement with another group member. (3) Disagreement-relevant intrusions; depict disagreement or challenges. (4) Delimitors, statements that offer a context, achieve a mutual understanding, or intent to avoid a refutation. The scheme includes an additional argument-irrelevant category: (5) nonarguables, statements that are off-topic or irrelevant in the discussion (Canary & Seibold, 2010).

Much of the research using CACS has focused on the discrete frequency distribution of arguments in-group discussion to analyze behavioral codes in interactions (Meyers & Brashers, 2010). Frequencies represent a static view in the interaction process, and are helpful to determine what arguments have higher incidence. However, understanding the dynamics embedded during the communication process require a deeper level of analysis that frequencies may not offer. A first step in the structuration analysis is to unveil the argumentative system, which involves an exploration of interactions to reveal temporal patterns. Therefore, this study uses Lag-Sequential Analysis -LSA to analyze the behaviors coded in the CACS. LSA estimates whether a "given" behavior influences the probability that a "target" behavior occurs (Bakeman & Gottman, 1997). In determining the cross-dependency between "given" and "target" behaviors, this interaction analysis method identifies temporal patterns that occur significantly more or less than expected by

Table 1
Conversational Argument Coding Scheme (CACS).

Code	Abbreviation	Example from transcript
I. ARGUABLES		
A. Generative Mechanisms		
1. *Assertions:* Statements of fact or opinion.	As	"I think the other problem it has is the hardship for people to pass through".
2. *Propositions:* Statements that call for support, action, or conference on an argument-related statement.	Pr	"we can also propose a way to pre-pay the canoe and retrieve it after"
B. Reasoning Activities		
3. *Elaborations:* Statements that support other statements by providing evidence, reasons, or other support.	El	"Because around this age he would still like to visit the park with his family, but perhaps, later on, it'll be his girlfriend."
4. Responses: Statements that defend arguables met with disagreement.	Re	"If it's too hi-tech, you can just do fingerprint. Fingerprint is not hi-tech."
5. *Amplifications:* Statements that explain or expound upon other statements in order to establish the relevance of the argument through inference.	Am	"When we want to listen to something we just search on the internet."
6. *Justifications:* Statements that offer validity of previous or upcoming statements by citing a rule of logic (provide a standard whereby arguments are weighed)	Ju	"More people utilizing it doesn't mean that it's going to be more efficient though."
II. CONVERGENCE-SEEKING ACTIVITIES		
7. *Agreement:* Statements that express agreement with another statement.	Ag	"Oh, yes, that works".
8. *Acknowledgement:* Statements that indicate recognition and/or comprehension of another statement, but not necessarily agreement with another's point.	Ac	"Yep, maybe not like a package tour to check around, but multiple options at least".
III. DISAGREEMENT-RELEVANT INTRUSIONS		
9. *Objections:* Statements that deny the truth or accuracy of an arguable.	Ob	"I don't think this is good. It is unstable".
10. *Challenges:* Statements that offer problems or questions that must be solved if agreement is to be secured on an arguable.	Ch	"The problem comes with the fact that if you create an account, you might have people misusing the service".
IV. DELIMITORS		
11. *Frames:* Statements that provide a context for and/or qualify arguables.	Fr	"The scenario is that the user eventually rode a bike over to the parking area, and discovered that our product has been fabricated and installed. So, after all the examination, this guy will ride a bike to his destination. And the steps can be about how he was facing some hardship before the appearance of our products till the point of it appearing".
12. *Forestall/Secure:* Statements that attempt to forestall refutation by securing common ground.	Fo	"I think everyone is going to learn this eventually"
13. *Forestall/Remove:* Statements that attempt to forestall refutation by removing possible objections.	For	"it's true that if you do all these kind acts every hour it might seem quite fishy."
V. NONARGUABLES		
14. *Process:* Non-argument related statements that orient the group to its task or specify the process the group should follow.	Pro	"Let's write about the point of view of the people nearby".
15. *Unrelated:* Statements unrelated to the group's argument or process (tangents, side issues, self-talk, etc.)	Un	"What did you guys eat yesterday?"
16. *Incompletes:* Statements that do not contain a complete, clear idea due to interruption or a person discontinuing a statement.	In	"So basically, because I encountered some problems so that…"

chance (Brauner et al., 2018).

Prior works studying group's creative process in a natural occurring setting have conducted different interaction analysis methods to unfold groups' discussions. Jackson and Poole (2003) developed a coding system through iterative analysis of idea generation episodes to uncover group interactions. Goldschmidt (2014) introduced linkography as a protocol analysis method for the design process. This method serves to identify links between design moves and to form a graphical representation of the design process. Harvey and Kou (2013) inductively analyzed groups' interaction by developing visual maps of the ideas' sequences (i.e., idea introduced, idea discussed and idea decided). Although the described methods help researchers to identify important insights of how interaction unfolds over the time, they are designed to capture only idea-related discussion. Moreover, they solely examine either idea generation or idea evaluation processes. However, the interest of this study is to examine interaction through group argumentation along the entire creative process, and to account for a method that identifies argumentative sequences in the course of groups' discussions. Therefore, LSA stands as a more suitable method to reveal argumentation patterns in this study.

2. Method

2.1. Participants

Eighty-eight undergraduate students from a public university in Tainan, Taiwan participated in this study for course credits. Audio-recorded discussions were the primary source of this study's data. Researchers did not consider nine participants for the analysis due to poor recording quality. The final sample comprised 79 participants (36 females; age range from 18 to 21 years; $M = 20.05$ and $SD = 0.83$). Most participants were Taiwanese (75) and four were from Belize, Paraguay, Indonesia, and Japan. All participants spoke Chinese fluently. Participants were first to fourth-year students enrolled in different academic colleges; Liberal Arts (10.13%), Science (5.06 %), Management (8.86 %), Engineering and Computer Science (45.57 %), Social Science (6.33 %), Medicine (8.86%), Bioscience and Biotechnology (6.33 %), and Planning & Design (8.86 %).

2.2. Procedures

The research setting of this study took place in a design course. Participants were first randomly assigned into nineteen groups (13 five-member groups, 5 four-member groups, and 1 three-member group). Most participants did not come from design or creativity-specialized academic backgrounds. During the design course, all participants received twelve lectures from different field experts. The content of the lectures focused on introducing concepts of creativity, human-center design methods, and design context case studies. As lectures were held, groups worked simultaneously in a series of workshops guided by facilitators. These workshops drew from the IDEO's design thinking process to address social impact challenges; how to reinforce a culture of generosity and how to support low-income families in Taiwan.

First, groups were asked to decide on a location in Tainan city that, according to their own perspectives, had the potential to improve its visitors' experience. Groups chose a variety of locations ranging from the parking area for bicycles near the train station, to the oldest department store in the city, 'Hayashi'. Following completion of selecting a location, groups were instructed to draw from the IDEO's design thinking methodology to deliver a creative solution that tackles the improvement of citizens' experience in the selected area. Finally, groups were advised that their solutions should be both novel and useful to be considered creative.

During the workshops, groups were asked to audio record their discussions. The main purpose was to analyze their argument systems, and how these design novices applied their training into their discussions. Workshop facilitators were trained to strictly only clarify task instructions if required and not to interfere with any part of the design process. There were no restrictions on how long participants could discussed for, however, most groups discussed for 120 minutes on average. All discussions were held in Chinese, and transcribed in English by a Taiwanese American research assistant who was proficient in both languages.

2.3. Data coding

Following many studies of creativity using coding schemes, two trained research assistants carried out the codification process of the English transcripts independently. First, the content collected in the discussions was divided into thought units defined as communicative acts that follow different grammatical specifications such as simple sentences, independent clauses, nonrestrictive dependent clauses, compound predicates, etc (Stiles, 1992). These specifications indicate when to code ideas as a single unit. For example, simple sentences express a single idea, thus they are coded as a single unit (e.g., "I will go out every weekend."). Independent clauses denote two or more ideas expressed in the same conversational turn, usually including conjunctions such as; and, but, or, so, if, and because. (e.g., "I think Taiwanese students don't want to go outside too often, because they can travel around anytime they want"). In this case, the two ideas split by the comma were coded as separate thought units.

The unitized transcripts were coded according to the relevant and non-relevant argument categories comprised in the CACS. The argument-relevant categories are task-related statements that are important for the development or closure of the discussion. Non-relevant arguments are statements that are off-topic or irrelevant in the task discussion. Because the purpose of this study focuses on the system and structure of group argument in a creative task discussion, the data coded in the non-relevant category was not consider for the subsequent analysis. To code the unitized transcripts and ensure its quality, coders followed the multistage coding process suggested by Meyers and Brashers (2010). This process consists in sorting the data into three levels, and assessing each level with the Cohen's Kappa statistic to check agreement between the two coders. The first level consisted on classifying the unitized

transcripts into relevant and non-relevant argument statements obtaining a Cohen's Kappa of .866. For the second level, coders sorted relevant utterances into four macro level categories (e.g., arguables, convergence-seeking activities, disagreement-relevant intrusions, and delimitors) obtaining a Kohen's Kappa of 0.794. In the third level, utterances already classified in the macro level categories where then classified into their respective subcategories obtaining a Cohen's Kappa of .954 for the convergence seeking activities, .844 for the delimitors, .937 for disagreements, .915 for generative mechanisms, and .841 for the reasoning activities.

2.4. Creative performance

To score creative performance, two independent raters blind to the purpose of this study, evaluated groups' solutions based on two creativity dimensions; novelty and usefulness (Runco & Jaeger, 2012). An outcome is novel when is considered as both new and original, and useful when is feasible and has a practical value to the society (Chulvi et al., 2012; Nijstad et al., 2010). To assess novelty, raters responded to the item: (a) the solution presented by the group is novel, unusual, and infrequent. To assess usefulness, coders responded to the items: (a) the solution presented by the group can be realized and implemented under consideration of realistic conditions, (b) the solution presented by the group is effective to tackle the problem raised, and (c) the solution presented by the group is useful. All items were rated on a seven-point Likert scale (1 = Strongly disagree; 7 = Strongly agree).

To ensure the reliability and validity of the creativity coding, both raters first calibrate their ratings according to an assessment criterion that the authors developed. After which, they discussed common issues and disagreements to reach consensus in their ratings. After training, both raters independently rated all the groups' solutions. After an initial round of rating, the ICC was 0.91 for novelty, and 0.89 for usefulness. To improve the accuracy of the coding, raters discussed cases with a more than 3-point discrepancy on a 7-point Likert scale. Finally, to analyze the communication patterns on groups with distinct differences in creativity, the sample was divided into three groups (i.e., high-, medium-, and low-performing) based on the rates provided by the two independent raters. High-performing groups contained the top 25% of high scores, and low-performing the bottom 25%. Differences between high and low-performing groups were uncovered using LSA.

2.5. Data analysis

This study employed Lag Sequential Analysis (LSA) to examine the system of argument across high and low creative performing groups. LSA is a methodology to explore temporal contingencies between group members in sequentially recorded behaviors (e.g., a proposition statement followed by an objection statement), and whether there exist behavioral sequences that occurred above chance. To analyze the results, researchers pooled the coded data from groups that obtained a high rated performance and low rated performance into two sets of data (Kauffeld & Meyers, 2009; Lehmann-Willenbrock et al., 2013; Lehmann-Willenbrock et al., 2011). To determine whether a specific argument (behavior) followed another argument, two first-order transition matrices of 13 by 13 squares, containing the transitions between conversational arguments, were generated with the Generalized Sequential Querier program (GSEQ 5.1), following procedures by Brauner et al. (2018). The so-called first order transition matrix occurs when one statement follows the previous one (lag 1). Then, using these transition frequencies, transition probabilities were calculated, which indicates the probability that a specific behavior B occurs immediately after a particular given behavior A. It is important to clarify that a high transition probability does not constitute an above chance transition frequency. Then, to evaluate whether the observed transition probabilities significantly differ from the unconditional probability for the specific behavior that follows, the z-statistic serves as a statistical check (Brauner et al., 2018). A z-value greater than 1.96 indicates that a sequence has occurred above chance and it is statistically significant. The output obtained from the GSEQ 5.1 contained a total of 871 and 1126 event sequences for high and low performance groups correspondingly.

After performing and obtaining results from the LSA, a second step in the development of the study is to analyze argument-as-structure. Since argument-as-structure is not directly observable within the content of the discourse, researchers built visual representations of all the transition patterns from high- and low-performing groups obtained from LSA. Then, researchers focused their attention into recognizing commonalities and differences across the visual representations of the argumentative patterns, and develop meaningful interpretations grounded on existing group creativity literature. Finally, the study provides explanations of why the system unfolds the way it does in the discussion section.

3. Results

The output obtained from the GSEQ 5.1 contained a total of 871 and 1126 event sequences for high- and low-performing groups

Table 2
Argument Frequencies of Low-Performance Groups.

	Arguments												
	As	Pr	El	Re	Am	Ju	Ag	Ac	Ob	Ch	Fr	Fo	For
Frequency	370	230	67	19	101	13	114	9	28	140	33	2	1
	32.8%	20.4%	5.9%	1.7%	9.0%	1.2%	10.1%	0.8%	2.5%	12.4%	2.9%	0.2%	0.1%

Note. Assertions (AS), Propositions (Pr), Amplifications (Am), Justifications (Ju), Elaborations (El), Responses (Re), Agreements (Ag), Acknowledgements (Ac), Objections (Ob), Challenges (Ch) Frames (Fr), Forestall Secure (Fo), Forestall Remove (For).

correspondingly. The frequency and percentage of each coded argument was calculated for high- and low-performing groups (see Tables 2 and 3). The most frequent kind of arguments exhibited by high and low performing groups were the generative mechanisms assertions (AS), propositions (Pr), and the disagreement-relevant intrusion and Challenges (Ch). On the contrary, the least frequent category of arguments were the delimiters (frames fr, forestall/secure Fo, and forestall/remove For).

Since the objective of LSA is to explore the temporal patterns in the observed sequences, all the coded conversational arguments were organized chronologically to calculate the frequencies with which each argument was followed by each of the others. The results of these calculations are presented in Tables 4 and 5 for low- and high-performing groups correspondingly. The left hand column represents the initial argument, and the row extending to the right from each item in that column, the frequency of each argument type. In Table 4 first row, for example, an initial assertion (AS) was followed by another assertion (As) in 135 out of 371 cases where the groups expressed an assertion; by a proposition (Pr) in 73 of those cases; by an elaboration (El) in 16 of those cases, and so on.

Once researchers obtained the frequencies of the transitions between conversational arguments, it was necessary to search for transition patterns, that is, the transitions that occur above chance. Then, researchers calculated Haberman's adjusted residuals with the software GSEQ 5.1 for all the transition between conversational arguments (Bakeman & Quera, 2011). According to (Brauner et al., 2018) when executing LSA, the adjusted residuals represent the z-scores when the row total is not small (not less than 30 behaviors) and the proportion between the expected transitions and the argument frequencies are not extreme (i.e., between 0.1 and 0.9). Consequently, the adjusted residuals in Tables 6 and 7 that are either greater or equal to 1.96, or lower or equal than -1.96 indicate the observed frequency differs significantly from the expected one, and then, since it is statistically significant it corresponds to a transition pattern.

Tables 6 and 7 shows de adjusted residuals for low and high performing groups correspondingly. Reading Table 6 it is possible to see that when the participants stated a proposition (Pr) the next argumentative behavior tend to be an amplification (Am) or a challenge (Ch). Similarly, from Table 7 it is possible to read what argumentative behaviors were more likely to occur before a specific argument. As an example, in high performing groups after group members stated an assertion (As), the following argument tended to be an assertion (As), a proposition (Pr), or a challenge (Ch). Following this logic, Fig. 2 provides a visual representation of the significant patterns obtained from the adjusted residuals tables.

Fig. 2 provides a visual representation of all the transition patterns from high- and low-performing groups. Arrows determine the initial and target arguments, and it displays the value of the adjusted residuals for each transition pattern to determine the prevalence of it (the higher the adjusted residual the more likely the transition is to occur). For example, after high-performing groups stated an assertion (As), they consistently responded with a challenge (3.39), a proposition (2.99) or another assertion (2.89). Similarly, when low-performing groups stated a proposition, they tended to respond with an amplification (3.89), or a challenge (2.31) (Fig. 2).

The study summarizes the comparative analysis of argument-as-system across high- and low-performing groups in Table 8. First, the predominant pattern of high-performing groups to generate ideas was AS→Ch→AS… AS→Pr→Ag. That is, once the group members provided a statement of fact or opinion, they presented issues that needed to be resolved if they wanted to accept or not the idea. Then they participated with more statements of opinion, and generated propositions calling for support to converge towards an agreement with the more predominant pattern Pr→Ag. However, after the proposition was stated they also tended to directly reject the idea proposed with an objection, and then defend the idea with a response Pr→Ob→Re. In contrast, low-performing groups' pattern for idea generation was predominantly Pr→Am… Am→Ag. That is, after the proposition of a new idea, they discussed to establish the relevance of it and then reached agreement. Still, low-performing groups tended, in a lower proportion, to respond to propositions with challenges, and then assertions (Ch→As). However, after these groups stated assertions to communicate an opinion, they did not incline to answer with a specific type of argument, so there is no significant pattern after the statement of an assertion. Additionally, after low-performing groups expressed a disagreement relevant intrusion (i.e., challenges, and objections) they tended to provide arguments to defend their argument and then make a proposition (Ch→Re→Pr and Ob→Re→Pr).

Second, high-performing groups continued developing the idea after they reached agreement with the sequence Ag→Ju→Am→El→Fr→Am→El→Ag, which mainly consist of utterances that use reasons to establish the relevance of the arguments (i.e., elaborations, amplifications, and justifications); and frames to provide context and qualify the ideas. Although there is a predominance of the pattern El→Ag, the use of reasoning arguments also tended to trigger challenges as response (El→Ch) that subsequently initiated an idea generation pattern. On the other hand, low performing groups tended to reach an agreement predominantly after the pattern Pr→Am →Ag

4. Discussion

Based on the observable patterns among high- and low- creative performing groups, this study yield two main findings. First,

Table 3
Argument Frequencies of High-Performance Groups.

	ARGUMENTS												
	AS	PR	EL	RE	AM	JU	AG	AC	OB	CH	FR	FO	FOR
FREQUENCIES	289	176	33	9	35	7	65	12	29	180	32	2	3
	33.1%	20.2%	3.8%	1.0%	4.0%	0.8%	7.5%	1.4%	3.3%	20.6%	3.7%	0.2%	0.3%

Note. Assertions (AS), Propositions (Pr), Amplifications (Am), Justifications (Ju), Elaborations (El), Responses (Re), Agreements (Ag), Acknowledgements (Ac), Objections (Ob), Challenges (Ch) Frames (Fr), Forestall Secure (Fo), Forestall Remove (For).

Table 4
Low performance Groups' Pattern of Transition between Conversational Arguments.

Initial Arguments	Target Arguments												
	As	Pr	El	Re	Am	Ju	Ag	Ac	Ob	Ch	Fr	Fo	For
As	135	73	16	3	32	6	37	5	8	47	6	1	1
Pr	63	40	14	0	33	2	24	3	5	37	9	0	0
El	13	17	10	3	2	1	11	0	2	6	2	0	0
Re	7	7	0	0	0	0	1	0	0	4	0	0	0
Am	24	19	12	0	13	2	20	0	1	5	5	0	0
Ju	1	3	2	1	0	0	3	0	1	2	0	0	0
Ag	41	25	7	0	10	0	8	0	5	15	3	0	0
Ac	2	2	1	0	0	0	0	0	0	4	0	0	0
Ob	8	1	1	6	3	0	2	0	2	4	1	0	0
Ch	73	31	4	5	3	2	10	0	0	8	3	1	0
Fr	4	8	1	0	5	0	5	1	3	2	4	0	0
Fo	0	0	0	1	0	0	0	0	0	1	0	0	0
For	0	0	0	0	0	0	0	1	0	0	0	0	0

Table 5
High Performance Groups' Pattern of Transition between Conversational Arguments.

Initial Arguments	Target Arguments												
	As	Pr	El	Re	Am	Ju	Ag	Ac	Ob	Ch	Fr	Fo	For
As	92	59	11	1	10	3	21	6	8	64	11	1	2
Pr	44	43	6	1	6	1	27	1	10	32	4	0	1
El	5	3	2	0	4	1	5	0	1	9	3	0	0
Re	3	3	0	0	1	0	1	0	0	0	1	0	0
Am	9	8	4	0	3	0	3	0	0	5	3	0	0
Ju	3	0	0	0	2	0	0	0	1	1	0	0	0
Ag	22	14	3	0	3	2	3	1	2	13	2	0	0
Ac	3	3	0	0	0	0	2	0	0	4	0	0	0
Ob	8	7	0	3	1	0	0	1	2	7	0	0	0
Ch	93	25	3	2	2	0	8	1	4	35	7	0	0
Fr	6	6	3	0	5	0	4	0	0	5	3	0	0
Fo	1	0	0	0	0	0	0	0	0	0	0	1	0
For	1	0	0	0	0	0	0	1	0	1	0	0	0

Table 6
Low performing groups Adjusted Residuals.

Initial Argument	Target Arguments												
	As	Pr	El	Re	Am	Ju	Ag	Ac	Ob	Ch	Fr	Fo	For
As	1.9	0.25	-1.43	-1.37	0.29	1.27	-0.13	1.38	-0.18	0.46	-1.61	0.61	1.52
Pr	-1.47	-0.55	0.36	-2.06	3.89	-0.26	0.33	0.98	-0.04	2.31	1.28	-0.67	-0.47
El	-2.24	1.37	3.36	2.03	-1.59	0.38	1.8	-0.76	0.42	-0.75	0.14	-0.34	-0.24
Re	0.64	2.17	-1.04	-0.53	-1.27	-0.44	-0.63	-0.38	-0.65	1.38	-0.71	-0.17	-0.12
Am	-1.52	0.2	2.99	-1.27	1.99	1.04	3.66	-0.92	-0.83	-2.09	1.55	-0.41	-0.29
Ju	-1.78	0.49	1.61	1.91	-1.05	-0.36	1.69	-0.32	1.41	0.48	-0.59	-0.14	-0.1
Ag	0.86	0.79	0.2	-1.4	0.22	-1.15	-1.14	-1.01	1.6	0.41	-0.08	-0.45	-0.32
Ac	-0.7	0.18	0.65	-0.38	-0.92	-0.32	-1.02	-0.28	-0.47	2.91	-0.52	-0.12	-0.09
Ob	-0.19	-2	-0.42	8.99	0.61	-0.53	-0.42	-0.47	1.87	0.53	0.34	-0.21	-0.15
Ch	5.38	1.03	-1.52	2.11	-2.75	0.48	-1.18	-1.13	-1.9	-2.36	-0.44	1.74	-0.35
Fr	-2.37	0.87	-0.63	-0.71	1.55	-0.59	1.07	1.49	2.76	-0.99	3.44	-0.23	-0.16
Fo	-0.93	-0.66	-0.34	5.78	-0.41	-0.14	-0.46	-0.12	-0.21	1.74	-0.23	-0.06	-0.04
For	-0.66	-0.47	-0.24	-0.12	-0.29	-0.1	-0.32	11.47	-0.15	-0.35	-0.16	-0.04	-0.03

argumentative systems constitute of disagreement relevant intrusions (i.e., challenges, and objections) play an important role on determining groups' creative performance. Results show that while challenges are beneficial to idea generation, objections are detrimental. This finding suggest that the positive or negative effects of disagreements depend on whether the system is driven by arguments that encourage or discourage collaboration. Second, findings reveal that building a shared understanding and seeking convergence are the structures that group members used to produce and sustain their argument system. By using argumentative systems characterized by challenges, reasoning activities, and frames, members of high performing groups shared their knowledge, assumptions, and values in order to achieve a collective shared understanding and reach consensus. In the case of low performing groups, although members produce argumentative systems that seek convergence, the absence of arguments denoting evaluation, reasoning or confrontation lead to prompt agreement and thus affecting their creative performance. These findings contribute to prior

Table 7
High Performance Adjusted residuals.

Initial Argument	Target Arguments												
	As	Pr	El	Re	Am	Ju	Ag	Ac	Ob	Ch	Fr	Fo	For
As	2.89	2.99	1.42	-0.77	0.81	1.37	0.9	1.94	0.57	3.39	1.42	0.97	1.9
Pr	0.21	4.05	0.79	-0.15	0.64	0.12	5.63	-0.63	3.29	1.19	-0.24	-0.54	1.07
El	-1.07	-0.75	1.4	-0.46	3.55	2.15	2.41	-0.57	0.37	2.15	2.55	-0.21	-0.26
Re	0.85	1.86	-0.46	-0.23	1.72	-0.2	0.78	-0.29	-0.43	-1.19	1.8	-0.11	-0.13
Am	0.4	1.64	3.55	-0.47	2.31	-0.41	0.78	-0.59	-0.88	0.01	2.43	-0.22	-0.27
Ju	1.37	-1.01	-0.4	-0.2	4.55	-0.18	-0.63	-0.25	2.33	0.06	-0.4	-0.1	-0.12
Ag	1.24	1.26	0.9	-0.71	0.8	2.79	-0.65	0.33	0.31	0.7	0.13	-0.33	-0.41
Ac	-0.02	0.98	-0.57	-0.29	-0.59	-0.25	1.51	-0.36	-0.54	1.66	-0.57	-0.13	-0.17
Ob	0.57	1.66	-0.85	6.74	0.31	-0.38	-1.33	1.38	1.79	1.5	-0.85	-0.2	-0.25
Ch	8.57	-0.39	-0.87	0.77	-1.46	-1.05	-1.02	-0.7	-0.1	1.47	1.13	-0.56	-0.69
Fr	-0.65	0.79	2.55	-0.46	4.67	-0.4	1.65	-0.57	-0.85	0.15	2.55	-0.21	-0.26
Fo	0.97	-0.54	-0.21	-0.11	-0.22	-0.1	-0.33	-0.13	-0.2	-0.56	-0.21	19.68	-0.06
For	0.49	-0.66	-0.26	-0.13	-0.27	-0.12	-0.41	5.95	-0.25	1.01	-0.26	-0.06	-0.08

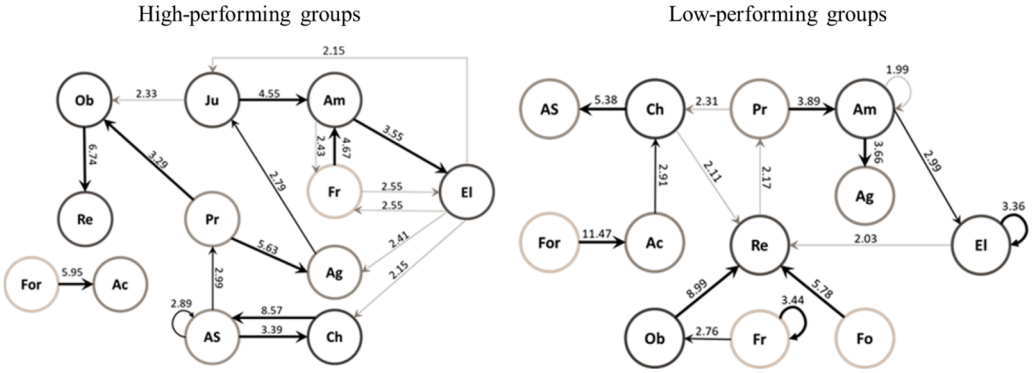


Fig. 2. Argumentative Behavior Patterns of High- and Low-creative performing groups. Note. Adjusted residuals are shown. Arrows show the initial and target arguments. Assertions (AS), Propositions (Pr), Amplifications (Am), Justifications (Ju), Elaborations (El), Responses (Re), Agreements (Ag), Acknowledgements (Ac), Objections (Ob), Challenges (Ch) Frames (Fr), Forestall Secure (Fo), Forestall Remove (For).

Table 8
Summary of argument-as-system. High and Low performing groups.

Groups	Predominant Patterns	Pattern Description
High-creative performing	AS→Ch→AS… AS→ Pr→Ag	Members' opinions initially serve to raise task issues. Resolving such issues produce more opinions and subsequently leads to the proposal of ideas. After this sequence, groups reach a preliminary agreement on the idea proposed.
	El→Ch→ AS… AS→ Pr	Elaboration of ideas trigger the emergence of challenges, which contribute to initiate another idea generation pattern.
	Ag→Ju→Am→El→Fr→Am→El→Ag	Consist of arguments that use reasons to build the ideas proposed. Frames are added to provide a context and establish a shared understanding among the diverse perspectives. Groups converge to an agreement after reasoning arguments validate the idea.
	Pr→Ob→Re	Proposed ideas are immediately rejected with an objection and later defended with a response.
Low-creative performing	Pr→Am… Am→Ag	The proposition of a new idea is expanded to reach agreement.
	Pr→Ch→As	Propositions are responded with challenges, and challenges with an opinion.
	Ch→Re→Pr	Challenges trigger members to defend the current idea and then propose alternatives.
	Ob→Re→Pr	Objections trigger members to defend the current idea and then propose alternatives.

work on the effect of socio-cognitive processes such as conflict, creative synthesis, and communication on group creative performance.

One of the main findings reveals that group creative performance may be subject to argumentative systems characterized by disagreements. This implication should be of special interest to group creativity researchers studying the effects of conflict. The existing conflict literature indicates diverse aspects interfering with group creative performance such as brainstorming instructions (Nemeth et al., 2004), cultural and knowledge diversity (Paletz et al., 2014; Stahl et al., 2010; West, 2002), and relationship and task conflict (De Dreu, 2006; Farh et al., 2010; Todorova et al., 2014). However, research findings constantly reflect a tension regarding the effect of conflict on group creative performance. While some studies suggest the potential value of it, others report a detrimental effect (De Dreu, 2006; Paletz et al., 2014; Paletz et al., 2018), In this regard, this study contributes to reconcile positive and negative research findings by unpacking the role of conflict on group creativity via argumentation analysis. Indeed, conflict is often conceptualized as a

socio-cognitive construct because it represents inter-individual confrontations originated from contradictory knowledge, values, and experiences (Buchs et al., 2004). Due to its socio-cognitive nature, conflict is considered to be better examined through expressed communication (Paletz et al., 2011). Thus, disagreements are arguments produced from individual cognition and reproduce through oral communication that serve to indicate when competing views or tensions arise among group members. During the communication process, disagreements have the ability to identify different interpretations that need some reconciliation to achieve an ultimate common goal. However, findings of this study report that the influence that disagreements have on group performance is contingent to how it is communicated.

According to the CACS, there are two different arguments related to disagreement relevant intrusions: objections, and challenges. This study suggest that while high-performing groups reflect argumentative systems that use challenges to generate ideas, low-performing groups use objections to respond to frames. In this case, challenges represent the possibility of a constructive conversation because they are statements that identify problems or questions that need solutions to procure consensus. This facilitates a collaborative communication practice where individuals experience freedom to state doubts and/or task related unconformities (De Dreu & Weingart, 2003; Lovelace et al., 2001). Furthermore, challenges may stimulate collective attention by motivating individuals to provide a response. As a result, members might feel encourage to draw on their creative thinking and seek for novel insights (Harvey, 2014; Miron-Spektor et al., 2011). In contrast, objections are more antagonistic and pessimistic because they directly deny the truth or accuracy of arguments. In the case of low-performing groups, members respond to a frame (statements that provide context) with an objection. Expressed frames seek to communicate an idea using examples or analogies to make it easily understood by others. According to Harvey (2014) individuals working in groups often use analogies in an attempt to find similarities between competing ideas with the objective to reach a share understanding of the problem, and conducts to a common solution. Thus, replying with an objection to a frame could be seen as a confrontational response to others' understanding, and might contribute to gradually brake social ties within the group. Chiu (2008b) states that polite disagreement contributes to collaboration in problem solving, but rude disagreement discourages collaboration. Providing a more contentious communication to the attempts of reaching a collective understanding could inhibit the sense of freedom to share information and develop new ideas (De Dreu, 2006). In sum, findings regarding argumentative systems driven by disagreements support the existing literature about the essential role of conflict in determining the creative level of groups. However, they extend research on the mixed-findings between the relationship of conflict and group creative performance from a communication perspective. More importantly, this study contributes to identify the type of arguments that enhance or inhibit creativity when conflict occurs.

Another finding reveals the argumentative systems that contribute to achieve a collective shared understanding. As group interaction unfolds, members work to integrate diverse ways of thinking. Thus, individual's understandings of specific situations ignite social interaction, and influences ways of thinking. This is consistent with a concept in group creativity known as Creative Synthesis -the reconciliation of competing views - that emerges from contradictions arising from individuals' interpretations of different situations during the interaction process as a driver of novelty (Harvey, 2014; Seo & Creed, 2002). According to this study's findings, arguments that express challenges, reasoning, and frames co-occur in the system to move high-performing groups towards a creative synthesis. First, synthesis requires challenging existing assumptions for the emergence of new ideas (Alvesson & Sandberg, 2011). Then, high-performing groups use challenges to ask better questions and reformulate ideas. Questioning involve new possibilities and new ways of understanding an idea (Chiu, 2008a). Second, the use of arguments that denote reasoning (e.g., justifications, amplifications, responses, and elaborations) offers the opportunity to stablish connections between different perspectives to capture new understandings. Evaluation of ideas is an indicator that groups are dealing with the tension produced by the existence of diverse perspectives and their desire to integrate them into a synthesis (Harvey & Kou, 2013). Third, the role of frames towards convergence suggest an effort from group members to provide a hypothetical or real-life context that serve to accomplish a common interpretation. Frames constitute a valuable mechanism for creative synthesis because it allows members to connect multiple considerations by reframing the discussed situations in terms that others can understand. Overall, this study shed light on the arguments that groups should adopt for the production of argumentative systems in order to achieve creative synthesis.

On the other hand, low-performing groups tend to reach agreement without much interaction after the proposition of a new idea. This indicates little effort to build a shared understanding among members. That is, once a new alternative is proposed, groups would prefer to reach agreement rather than confront a challenge or expand the reasoning of their own and others' ideas. This implication resonates with the Groupthink phenomena. According to Janis (1983), groupthink is the desire of members to converge quickly without further reasoning of their ideas resulting in poor group outcomes. The loose link between questioning of ideas and the production of alternatives serves as an antecedent that may cause Groupthink in low-performing groups. This suggests a tendency to avoid conflict affecting the generation of new ways of thinking, and consequently the integration of diverse perspectives using reasoning behaviors to evaluate and elaborate ideas (Park, 1990). Despite the literature recognizing the detrimental effect of quick convergence on groups processes, this study contributes to show empirical evidence that low-creative performing groups produce argumentative systems based on their need to reach early discourse closure.

5. Implications for education

Exploring and understanding the creative process is relevant for education as education is responsible for continuously developing the creative skills of new professionals. As creativity is a fundamental life skill for the 21st century, not only for the development of goods and services, but for the production of new knowledge as well, it is essential to unveil and describe the mechanisms that produce creative ideas, and understand elements that hinder or enhance its results. This knowledge is essential to improve the development of individuals' creative skills, before they have to face natural environments with ill-defined problems.

This study directly observes undergraduate students' group discussions during a creative session. Examining students' intra-group interactions shed light on how argumentation shapes students' creative process. Importantly, findings of this study contribute to inform educators as to what type of arguments and interactions should be promoted, or avoided during group discussions in order to enhance students' creative performance. First, educators should encourage undergraduate students to use arguments such as challenges instead of objections to promote collaboration in their creative discussions. Challenges call groups' attention to collectively solve unanswered questions, leading students' cognitive engagement towards searching new possibilities. However, objections may discourage students to express their ideas. Without new inputs, groups could fall into a stagnant situation that may lead to less creative outcomes. Second, educators should emphasize on the importance of building argumentative patterns that contribute to integrate diverse perspectives. This study suggests that creative success is likely to be achieved when groups stablish a collective shared understanding through the use of arguments that express reasons, questions, and examples. Third, educators can be trained to recognize when the quality of groups' argumentation is weak. The lack of interaction between members and groups tendency to urgently achieve a concrete solution are some indicators that requires educators' attention to guide students in moving the discourse in another argumentative direction.

Finally, of particular importance to education is an emphasis on the conception of creativity as a collaborative argumentation process. If educators are aware on the importance of communication, it could produce new methodologies to assess and provide feedback to students on their group performance. Rather than basing results only on final ideas presented, new assessment methods could incorporate the reflection on the experience of working collaboratively.

6. Limitations and future research

This study is situated in a naturalistic setting instead of a controlled condition. Although this research context may favor the unrestricted development of group arguments, it may also imply certain limitations. Instead of framing the design challenge into a specific problem, this study asks participants to work on an opportunity-based task. This may impact argumentation and creative outcomes because groups have to deal with a high degree of ambiguity to frame the problem. Researchers have suggested ambiguous environments ideal for the generation of creative ideas (Dillon, 1982; Weisberg, 1988). However, it could also raise frustrations and confrontations. Specially, for participants without prior experience in design practices.

This study examines argument-as-structure as the collective resources employed to produce and sustain groups' argumentative patterns. However, other type of resources such as individual- or context-derived can provide explanations about argument-as-structure. For instance, groups are the collection of individuals with different personalities and cognitive skills working towards a single goal. It is likely that these individual characteristics in-group composition have interfered with the results obtained in this study. In fact, it could be possible to hypothesize the link between the individual need for cognitive closure and the poor quality of group argumentation that yield to quick consensus in low creative performing groups (Ortega-Martín et al., 2021). Future studies can adopt research settings where individual differences are measured and controlled.

In addition, participants of this study were Taiwanese undergraduate students from the same university. Such uniform institutional and cultural context may have influenced the argumentative systems produced by the groups. For example, Taiwanese society recognizes social harmony as a central cultural value that promotes cooperation instead of confrontation (Ip, 2014). Such cultural value may become relevant for the study of argumentation because it informs about how individuals address conflict in a social activity. On the contrary, western societies possess an individualistic value orientation that encourage competition, and a contentious communication style. Similarly, while some universities adopt argumentation practices to construct new knowledge, others might be less argumentative oriented in their learning methods. Likewise, colleges provide a disciplinary culture that serves to structure individuals' knowledge to address a problem from a disciplinary perspective (Chiu et al., 2013). Since participants of this study belong to different academic programs, disciplinary culture might play an important role for group argumentation. In fact, the high proportion of engineering and computer science students may influence the discussion of their groups towards innovation and elaboration of novel ideas. However, the effect of non-design students on group interaction might be different. For example, management students could direct group discussions towards consensus, as they may possess a goal-oriented value. Moreover, disciplinary culture could lead to intellectual centrism, that is, the belief that one's expertise takes precedence over others (Banerjee & Chiu, 2018). Further research could investigate argumentative interaction when disciplinary culture phenomena such as intellectual centrism emerge. In sum, universities and colleges shape students' knowledge and their argumentative capacities (Muller Mirza et al., 2009). Thus, considering different cultural and institutional context in which group argumentation and creativity is situated would be pertinent for future studies in the education field.

Finally, the data was obtained from audio instead of video-recorded sessions. This represent a limitation in capturing nonverbal interactions. In many cases, physical behavior such as facial expressions and gestures serve as a conversational act (e.g., one person nodding his head could express disagreement) and it might provide valuable information about how arguments are delivered, and interpreted by others. Future research designs could capture both verbal and nonverbal behaviors and observe whether they mutually complement in the argumentation. Additionally, another limitation relates to the translation of Chinese discussions to English transcripts. Although researchers followed literature suggestions of using only one translator to ensure the quality of translated transcripts (Twinn, 1997), aspects such as the complexity of translating Chinese words with no equivalent in English may compromise the consistency of the translation. Further research could use more than one translator to strengthen the reliability and validity of the data analysis.

7. Conclusion

As professionals require creativity and group work skills to address real-world challenges, studying group creativity effectiveness becomes more relevant not only for organizations, but for the education field. This study used a communication approach, specifically structuration theory, to explore the argumentative interactions that lead groups working on a creative task to be more or less successful. This research suggests that both conflict towards collaboration and achieving a collective shared understanding are the underneath group structures that sustain the argumentative system of high-creative performing groups. On the contrary, seeking prompt convergence on a single solution and contentious conflict are the underneath group structures that characterizes the argumentative patterns of low-creative performing groups. In this sense, findings highlight the importance of promoting argumentative systems constituted by arguments that express reasoning and challenges instead of objections.

CRediT authorship contribution statement

Ingrid P. Hernandez Sibo: Conceptualization, Investigation, Writing – original draft. **David A. Gomez Celis:** Methodology, Software, Formal analysis. **Shyhnan Liou:** Supervision. **Brandon Koh:** Writing – review & editing. **Angela K.Y. Leung:** Supervision.

Declaration of Competing Interest

None.

Data availability

Data will be made available on request.

Acknowledgments

None.

References

Alvesson, M., & Sandberg, J. (2011). Generating research questions through problematization. *Academy of management review, 36*(2), 247–271.
Bakeman, R., & Gottman, J. M. (1997). *Observing interaction: An introduction to sequential analysis*. Cambridge university press.
Bakeman, R., & Quera, V. (2011). *Sequential analysis and observational methods for the behavioral sciences*. Cambridge University Press.
Banerjee, P. M., & Chiu, C. (2018). Professional biculturalism enculturation training: A new perspective on managing the r&d and marketing interface. In *Current topics in management* (pp. 145–160). Routledge.
Brauner, E., Boos, M., & Kolbe, M. (2018). *The Cambridge handbook of group interaction analysis*. Cambridge University Press.
Brown, V., Tumeo, M., Larey, T. S., & Paulus, P. B. (1998). Modeling cognitive interactions during group brainstorming. *Small Group Research, 29*(4), 495–526.
Buchs, C., Butera, F., Mugny, G., & Darnon, C. (2004). Conflict elaboration and cognitive outcomes. *Theory into Practice, 43*(1), 23–30.
Burnard, P. (2006). Reflecting on the creativity agenda in education. *Cambridge Journal of Education, 36*(3), 313–318.
Burns, T. R., Machado, N., & Corte, U. (2015). The sociology of creativity: Part I: Theory: The social mechanisms of innovation and creative developments in selectivity environments. *Human Systems Management, 34*(3), 179–199.
Calhoun, C. (1993). Identity and Control: A Structural Theory of Social Action.
Canary, D. J., & Seibold, D. R. (2010). Origins and development of the conversational argument coding scheme. *Communication Methods and Measures, 4*(1-2), 7–26.
Chiu, C. Y., Kwan, L. Y. Y., & Liou, S. (2013). Culturally motivated challenges to innovations in integrative research: Theory and solutions. *Social Issues and Policy Review, 7*(1), 149–172.
Chiu, M. M. (2008a). Effects of argumentation on group micro-creativity: Statistical discourse analyses of algebra students' collaborative problem solving. *Contemporary Educational Psychology, 33*(3), 382–402.
Chiu, M. M. (2008b). Flowing toward correct contributions during group problem solving: A statistical discourse analysis. *The Journal of the Learning Sciences, 17*(3), 415–463.
Chulvi, V., Mulet, E., Chakrabarti, A., López-Mesa, B., & González-Cruz, C. (2012). Comparison of the degree of creativity in the design outcomes using different design methods. *Journal of Engineering Design, 23*(4), 241–269.
Cragan, J. F., & Wright, D. W. (1990). Small group communication research of the 1980s: A synthesis and critique. *Communication Studies, 41*(3), 212–236.
Davies, D. (2004). Creative teachers for creative learners-a literature review. Undated, Internet Available: www.ttrb.ac.uk/attachments/c3096c7b-da04-41ef-a7ac-50535306e8fb.pdf.
De Dreu, C., Baas, M., & Nijstad, B. A. (2012). Chapter 10 - The emotive roots of creativity: Basic and applied issues on affect and motivation. In M. D. Mumford (Ed.), *Handbook of organizational creativity* (pp. 217–240). Academic Press. https://doi.org/10.1016/B978-0-12-374714-3.00010-0.
De Dreu, C. K. (2006). When too little or too much hurts: Evidence for a curvilinear relationship between task conflict and innovation in teams. *Journal of Management, 32*(1), 83–107.
De Dreu, C. K., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: a meta-analysis. *Journal of Applied Psychology, 88*(4), 741.
Dillon, J. T. (1982). Problem finding and solving. *The Journal of Creative Behavior*.
Drazin, R., Glynn, M. A., & Kazanjian, R. K. (1999). Multilevel theorizing about creativity in organizations: A sensemaking perspective. *Academy of Management Review, 24*(2), 286–307.
Farh, J.-L., Lee, C., & Farh, C. I. (2010). Task conflict and team creativity: a question of how much and when. *Journal of Applied Psychology, 95*(6), 1173.
Getz, I., & Lubart, T. (2009). Creativity and economics: Current perspectives. *The Routledge Companion to Creativity*, 206–221.
Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. Univ of California Press.
Goldschmidt, G. (2014). *Linkography: Unfolding the design process*. Mit Press.
Hargadon, A. B., & Bechky, B. A. (2006). When collections of creatives become creative collectives: A field study of problem solving at work. *Organization Science, 17*(4), 484–500.

Harvey, S. (2014). Creative synthesis: Exploring the process of extraordinary group creativity. *Academy of Management Review, 39*(3), 324–343.
Harvey, S., & Kou, C.-Y. (2013). Collective engagement in creative tasks: The role of evaluation in the creative process in groups. *Administrative Science Quarterly, 58*(3), 346–386.
Ip, P.-K. (2014). Harmony as happiness? Social harmony in two Chinese societies. *Social Indicators Research, 117*(3), 719–741.
Jackson, M. H., & Poole, M. S. (2003). Idea-generation in naturally occurring contexts: Complex appropriation of a simple group procedure. *Human Communication Research, 29*(4), 560–591.
Jackson, S., & Jacobs, S. (1980). Structure of conversational argument: Pragmatic bases for the enthymeme. *Quarterly Journal of Speech, 66*(3), 251–265.
Janis, I. L. (1983). *Groupthink*. Houghton Mifflin Boston.
Jehn, K. A., & Mannix, E. A. (2001). The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance. *Academy of Management Journal, 44*(2), 238–251.
Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter: Effects of team meetings on team and organizational success. *Small Group Research, 43*(2), 130–158.
Kauffeld, S., & Meyers, R. A. (2009). Complaint and solution-oriented circles: Interaction patterns in work group discussions. *European Journal of Work and Organizational Psychology, 18*(3), 267–294.
Kratzer, J., Leenders, O. T. A., & Engelen, J. M.v. (2004). Stimulating the potential: Creative performance and communication in innovation teams. *Creativity and Innovation Management, 13*(1), 63–71.
Lehmann-Willenbrock, N., Allen, J. A., & Kauffeld, S. (2013). A sequential analysis of procedural meeting communication: How teams facilitate their meetings. *Journal of Applied Communication Research, 41*(4), 365–388.
Lehmann-Willenbrock, N., Meyers, R. A., Kauffeld, S., Neininger, A., & Henschel, A. (2011). Verbal interaction sequences and group mood: Exploring the role of team planning communication. *Small Group Research, 42*(6), 639–668.
Lovelace, K., Shapiro, D. L., & Weingart, L. R. (2001). Maximizing cross-functional new product teams' innovativeness and constraint adherence: A conflict communications perspective. *Academy of Management Journal, 44*(4), 779–793.
Meyers, R. A., & Brashers, D. (2010). Extending the conversational argument coding scheme: Argument categories, units, and coding procedures. *Communication Methods and Measures, 4*(1-2), 27–45.
Meyers, R. A., Seibold, D. R., & Brashers, D. (1991). Argument in initial group decision-making discussions: Refinement of a coding scheme and a descriptive quantitative analysis. *Western Journal of Communication (includes Communication Reports), 55*(1), 47–68.
Miron-Spektor, E., Gino, F., & Argote, L. (2011). Paradoxical frames and creative sparks: Enhancing individual creativity through conflict and integration. *Organizational Behavior and Human Decision Processes, 116*(2), 229–240.
Muller Mirza, N., Perret-Clermont, A.-N., Tartas, V., & Iannaccone, A. (2009). Psychosocial processes in argumentation. *Argumentation and education* (pp. 67–90). Springer.
Nemeth, C. J., Personnaz, B., Personnaz, M., & Goncalo, J. A. (2004). The liberating role of conflict in group creativity: A study in two countries. *European Journal of Social Psychology, 34*(4), 365–374.
Nijstad, B. A., De Dreu, C. K., Rietzschel, E. F., & Baas, M. (2010). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology, 21*(1), 34–77.
Nijstad, B. A., & Stroebe, W. (2006). How the group affects the mind: A cognitive model of idea generation in groups. *Personality and Social Psychology Review, 10*(3), 186–213.
Ortega-Martín, J. L., Portnova, T., Zurita-Ortega, F., & Ubago-Jiménez, J. L. (2021). Correlation between the need for cognitive closure and narrative creativity in secondary education. *International Journal of Environmental Research and Public Health, 18*(8), 4333.
Paletz, S. B., Miron-Spektor, E., & Lin, C.-C. (2014). A cultural lens on interpersonal conflict and creativity in multicultural environments. *Psychology of Aesthetics, Creativity, and the Arts, 8*(2), 237.
Paletz, S. B., Schunn, C. D., & Kim, K. H. (2011). Intragroup conflict under the microscope: Micro-conflicts in naturalistic team discussions. *Negotiation and Conflict Management Research, 4*(4), 314–351.
Paletz, S. B., Sumer, A., & Miron-Spektor, E. (2018). Psychological factors surrounding disagreement in multicultural design team meetings. *CoDesign, 14*(2), 98–114.
Park, W. W. (1990). A review of research on groupthink. *Journal of Behavioral Decision Making, 3*(4), 229–245.
Paulus, P. B., & Brown, V. R. (2007). Toward more creative and innovative group idea generation: A cognitive-social-motivational perspective of brainstorming. *Social and Personality Psychology Compass, 1*(1), 248–265.
Paulus, P. B., Coursey, L. E., & Kenworthy, J. B. (2019). Divergent and convergent collaborative creativity. *The Palgrave handbook of social creativity research* (pp. 245–262). Springer.
Perelman, C., & Olbrechts-Tyteca, L. (1969). *The new rhetoric: a treatise on argumentation, trans* (p. 19). Notre Dame, IN: University of Notre Dame Press, 1969. *John Wilkinson and Purcell Weaver*.
Reiter-Palmon, R., & Sands, S. (2015). Creativity and meetings: Do team meetings facilitate or hinder creative team performance?.
Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal, 24*(1), 92–96. https://doi.org/10.1080/10400419.2012.650092
Seibold, D. R., McPhee, R. D., Poole, M. S., Tanita, N. E., & Canary, D. J. (1981). Argument, group influence, and decision outcomes. In *Dimensions of argument: Proceedings of the second SCA/AFA summer conference on argumentation*.
Seibold, D. R., & Weger, H. (2017). The conversational argument coding scheme. In *Researching interactive communication behavior: A sourcebook of methods and measures* (pp. 159–174).
Seo, M.-G., & Creed, W. D. (2002). Institutional contradictions, praxis, and institutional change: A dialectical perspective. *Academy of management review, 27*(2), 222–247.
Shaheen, R. (2010). Creativity and education. *Creative Education, 1*(3), 4. https://doi.org/10.4236/ce.2010.13026. Article 3369.
Sonnenburg, S. (2004). Creativity in communication: A theoretical framework for collaborative product creation. *Creativity and Innovation Management, 13*(4), 254–262.
Stahl, G. K., Maznevski, M. L., Voigt, A., & Jonsen, K. (2010). Unraveling the effects of cultural diversity in teams: A meta-analysis of research on multicultural work groups. *Journal of International Business Studies, 41*(4), 690–709.
Stiles, W. B. (1992). *Describing talk: A taxonomy of verbal response modes*. Newbury Park: Sage Publications.
Todorova, G., Bear, J. B., & Weingart, L. R. (2014). Can conflict be energizing? A study of task conflict, positive emotions, and job satisfaction. *Journal of Applied Psychology, 99*(3), 451.
Toulmin, S. (1958). *The uses of argument*. Cambridge, UK: Cambridge University Press.
Twinn, S. (1997). An exploratory study examining the influence of translation on the validity and reliability of qualitative data in nursing research. *Journal of Advanced Nursing, 26*(2), 418–423.
Weisberg, R. W. (1988). Problem solving and creativity. *The Nature of Creativity: Contemporary Psychological Perspectives*, 148.
West, M. A. (2002). Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups. *Applied Psychology, 51*(3), 355–387.
Woodman, R. W., Sawyer, J. E., & Griffin, R. W. (1993). Toward a theory of organizational creativity. *Academy of Management Review, 18*(2), 293–321.