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Understanding online collaboration through speech acts associated to Belbin profiles

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Abstract: During co-design sessions with students, we explored the link between Belbin's profiles, roles used in project management and speech acts used to specify the speaker's intentions, which are complementary keys of successful collaboration. Identifying links between each Belbin's profile and some particular speech acts would allow us to consider automatically identifying team members' roles or recommending ways to better communicate. For this study, discourses of 14 groups have been coded in speech acts and analyzed to find links with the primary and secondary Belbin's profiles of 31 students. We were interested in the proportion of speech acts per Belbin's profile. We found some links as the coordinator profile intervenes less often, but answers more questions from the team or the completer-finisher profile often validates the interventions of the others members. Extending this work would involve analyzing speech acts patterns links with Belbin's roles and how this can support successful collaborations.

Introduction

Success in collaborative group work depends on many aspects, such as group size (Kooloos et al., 2011), human factors like group cohesion and animation, or individual participation and motivation. In a collaborative group, each participant individually plays a different role, which can be assigned or emergent (De Wever & Strijbos, 2021). Belbin's (2010) work has shown that team members take on different roles in order to collaborate in cases of project management, and the balance between these roles impact group dynamics and effectiveness. Belbin has defined height complementary team roles divided into three categories (thinking, social and action) with strengths and weaknesses, used unconsciously by team members when they are working together. Using a questionnaire, team members can be identified as one or different role(s), determining how they can best contribute to the group, and conversely, which roles will be difficult for them to play. In learning collaboration groups, some studies tried to optimize group configuration using Belbin roles (Meslec & Curşeu, 2015), noting that they "positively predict group performance at least at the initial phases of the group work and it positively predicts group cognitive complexity. Nevertheless, it links negatively with teamwork quality". In a serious game for group business projects, Romanova (2018) found that having at least one finisher and one implementer was positive for success whereas plant, evaluator and shapers were not, also noting that it seemed important to avoid having "minorities" subgroups within a group (such as friends).

Different works have studied links between successful collaboration and discourse (Borge et al., 2019; McNair et al., 2010). McNair et al. (2010) based their study on speech acts from Austin (1962)'s original five categories (performative, assertive, directive, expressive and commissive) and they "show correlations between language practices and successful collaboration". Nasir et al. (2021)'s latest work has shown a link between speech behaviors and behavioral profiles, which seems "to be the most significant discriminatory factor". We can imagine a similar link between Belbin's roles and speech acts. The only work the authors are aware of that tried to combine team roles using Belbin's taxonomy and speech acts in an educational context is from Pöysä-Tarhonen et al. (2016): roles are used to form teams initially and then the authors assess performance and teams' development through a speech act analysis. However, they do not analyze the relationship between the roles themselves and the speech acts. Our work tries to fill this gap by identifying if there are links between speech acts defined by McNair and Belbin's collaboration profiles, and opening up new perspectives such as automatically identifying the roles of participants, recommending to communicate with some specific speech acts according to roles to build trust that helps successful collaborations (Holton, 2001) which is more difficult remotely. We tried to answer the following research question: is each Belbin's profile linked to some particular speech acts? Intuitively, we can think that some speech acts' categories may be more used by some roles, e.g. performative speech acts (which perform a change) may be more present for action-type roles, expressive speech acts (which express an attitude

about a person, thing or situation) for social-type roles. This work is included in the P3 project, developed by Université de Lille and co-financed by the iSite Université Lille Nord-Europe.

Materials and method

Material

Our data comes from co-design sessions with n=57 students 18-19 years old distributed in 18 small groups of 2 to 4 members. Each group had to collaborate to co-design a learning analytics dashboard (LAD) for their studies. Students worked together online through a web-conferencing tool (Discord) using speech and chat for about 90 minutes (M=109, SD=21) – the maximum time allowed was 150 minutes to allow for the introduction of the task before and a debriefing phase after. With the participants agreement, we recorded their screen as well as the vocal and textual interactions of each group. On a voluntary basis, after their sessions, students individually filled out Belbin's questionnaire (2010), an evaluation about the perceived group dynamic using with a 5-point Likert scale, how well they know other members of the group (using a 4-point scale ranging from "unknown" to "best friend") and they could attribute 10 points to define the best LAD(s) among all the LAD designed by all students (including their own). For this study, we kept only the groups with records and an identified team role for at least one of the team members, which reduces the data to 14 groups and n=45 students with 31 associated primary team roles (and 70 primary and secondary team roles).

Method

In order to investigate a possible link between Belbin's roles and speech acts, we needed to define speech acts used by each participant during collaborative sessions before analyzing it with their Belbin's profile. To identify speech acts used during the collaboration, we first defined a coding scheme. We looked at different previous works (Erkens & Janssen, 2008; Kim et al., 2006; Marttunen & Laurinen, 2009; McNair et al., 2010; Viswanathan & Vanlehn, 2019) to find a coding scheme adapted for our goal. We based our coding scheme on a mix of three schemes (Kim et al.[1], 2006; Marttunen & Laurinen[2], 2009; McNair et al.[3], 2010), which were the closest to our study context in learning activities. We defined 17 speech acts adapted for our study:

- Performative (perform a change): action validation (associated with an action)[1]
- Assertive (assert views or truth about something): information sharing[3], constructive comments and suggestions[123], answer to a question[12], accountability[3], developing a previous argument[12] and correct, objectify or criticize (disagree) [1]
- Directive (try to make others do something): request for comment or suggestion on an achievement[23], request for information/question[123], order a member[1]
- Expressive (express attitude about a person, thing or situation): expression of motivation (positive or negative) [3], validation or support of another group member's contribution[123], desire to contribute (positive or negative)[3] and recognition of benefit of group work[3]
- Commissive (commit the speaker to a certain course of action): validation of an assignment, acceptance of a role or task
- Others: summary[2] and off topic (other dimension not coded)

Using this coding scheme, we listened to each group discussion and we coded a total of 22073 utterances from 22 hours of records. When some groups had audio issues, they expressed through the chat of the web conferencing tool and we coded these interventions as well. Data were coded with the annotation tool ELAN by two annotators (12 groups for one annotator and 2 groups for the second). Agreement between annotators was estimated by coding two identical segments of 50 minutes from two groups (kappa = 0.52 – a value usually considered as indicating a moderate agreement). Difficult cases such as irony or sarcasm were discussed with two external experts.

For each student, speech acts were summarized as the proportion of specific categories of speech acts (performative, assertive, directive, expressive and commissive) relative to the total number of speech acts for the student. Continuous variables are expressed as mean ± SD or median [25th – 75th percentile], as appropriate. Categorical variables are presented as absolute numbers and percentages. Comparisons of two populations were performed by a Student's t-test or Wilcoxon test for continuous variables (the normality of the variables was assessed by a Shapiro–Wilk test). One-way analysis of variance (ANOVA) was used to compare means of more than two populations. ANOVA underlying assumptions were visually inspected with residual plots, and the normality assumption of the residuals was assessed by a Shapiro-Wilk test. Statistical analysis plan did not include adjustments for correcting for multiple comparisons in this exploratory study. Analyses were conducted using SAS software (SAS v9.4, SAS Institute Inc., Cary, NC, USA).

Results

For the 31 students who answered to the Belbin's questionnaire, we considered the primary (highest score) profile alone, as well as the primary and secondary (second highest score) profiles, as previously done by other works such as Romanova (2018). It is indeed common, according to Belbin's theory, for someone to be able to embody more than a single role. In case of a tie in scores for the primary or secondary role, we also counted the tied role(s). All profiles are represented except the plant one which is missing in our sample of students (cf. Table 1).

Table 1 - *Belbin's profiles repartition in the sample*

Code	Belbin's profile	Category	Sample (n=31)	Primary profile	Secondary profile
B1	Coordinator	Social	5 (16%)	4 (13%)	1 (3%)
B2	Implementer	Action	10 (32%)	3 (10%)	7 (23%)
B3	Plant	Thinking	0 (0%)	0 (0%)	0 (0%)
B4	Resource-investigator	Social	8 (26%)	3 (10%)	5 (16%)
B5	Monitor-evaluator	Thinking	11 (35%)	5 (16%)	6 (19%)
B6	Shaper	Action	13 (42%)	6 (19%)	7 (23%)
B7	Teamworker	Social	14 (45%)	7 (23%)	7 (23%)
B8	Completer-finisher	Action	9 (29%)	4 (13%)	5 (16%)

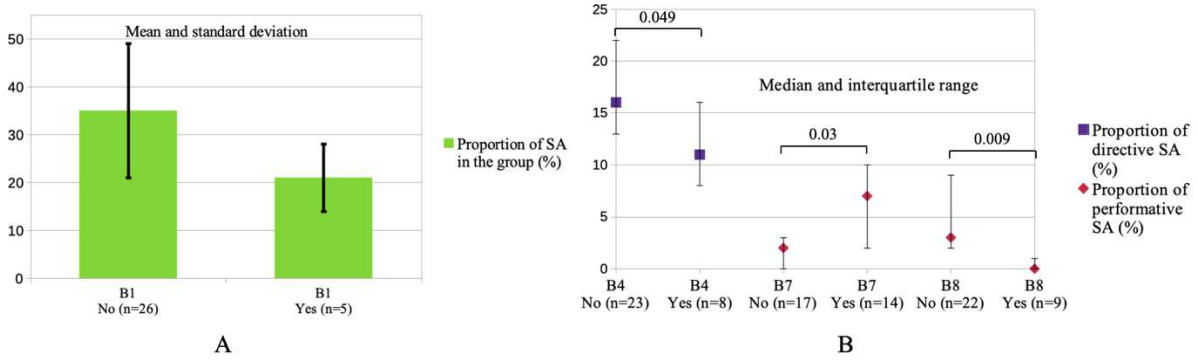
We can see in table 2 that the majority of SA are assertive, regardless of the profile, and that no statistically significant link can be established between the primary profile and a speech act category.

Table 2 - *Belbin's primary profiles repartition by speech act (SA) category*

	B1	B2	B4	B5	B6	B7	B8	p
SA in the group (%)	23 ± 4	31 ± 7	15 ± 5	35 ± 18	40 ± 14	37 ± 10	35 ± 20	0.16
SA assertive (%)	51 ± 8	50 ± 13	59 ± 8	48 ± 5	43 ± 10	42 ± 6	48 ± 11	0.19
SA commissive (%)	1 ± 1	1 ± 1	1 ± 1	1 ± 1	2 ± 1	1 ± 1	1 ± 1	0.56
SA directive (%)	13 ± 5	18 ± 14	10 ± 2	21 ± 10	16 ± 7	19 ± 5	17 ± 5	0.28
SA expressive (%)	26 ± 14	15 ± 7	22 ± 8	22 ± 9	27 ± 7	22 ± 7	25 ± 9	0.67
SA performative (%)	0 [0 ;2]	2 [1 ;10]	1 [1 ; 3]	2 [2 ;10]	4 [2 ;6]	5 [2 ;9]	5 [1 ;9]	0.38
SA others (%)	6 [6 ; 12]	11 [9 ;15]	5 [3 ; 9]	1 [1 ; 3]	5 [4 ;8]	10 [6 ;16]	5 [4 ;5]	0.07

We then considered speech acts categories (cf. Figure 1 for the statistically significant results): the coordinator seems to have less intervention than the other roles (no B1 mean=35±14, B1 mean=21±7), the resource-investigator seems to have less directive speech acts than others (no B4 median=16[13;22], B4 median=11[8;16]), and performative speech acts seem to be more used by the teamworker (no B7 median=2[0;3], B7 median=7[2;10]), while the complete-finisher seems to almost never use them (no B8 median=3[2;9], B8 median=0[0;1]).

Figure 1 - *Statistically significant results between links Belbin's profile and SA categories*



Finally, analyzing the speech acts themselves, we can see the coordinator answered more questions than the other roles (no B1 mean=20±8, B1 mean=29±11), and at the opposite, the teamworker answered less questions than others (no B7 mean=24±9, B7 mean=18±7) and expressed contributing or working more than the others (no B7 median=2[0;3], B7 median=7[2;10]). The completer-finisher seemed to validate more team's contributions of the others (no B8 median=17[15;21], B8 median=23[19;26]).

Discussion

The lack of links between the primary Belbin's profile and speech acts categories can be explained by the team members different roles during collaboration, emphasizing the importance of secondary Belbin's profiles. The coordinators seem to play a team-leader role: they may focus on the team's objectives and thus intervene less

often, but perhaps more to guide others by answering questions. The resource-investigators might be less directive because they bring solutions, ideas, but do not guide others. On the other hand, the teamworkers answer fewer questions, but express the actions they carry out, whereas intuitively they would be expected to use SA that creates a link, such as motivation. Finally, the completer-finishers talked less about the actions they carried out: as it is an action profile, they may not find it useful to express it, but they often validated the ideas and actions of other members of the team, probably allowing work to be completed.

Conclusion

We identified some links between Belbin's team roles and some speech acts. For example, the coordinator intervenes less than the other profiles, the resource-investigator is less directive than the others, the teamworker has more performative speech acts contrary to the completer-finisher who did not use this type of speech act. Still ongoing analysis using other indicators (such as the evaluation about the perceived group dynamic and the evaluation of groups productions) will allow us to complete this first approach and more research with bigger samples need to be pursued to confirm this first result. Our research thus far has introduced potential themes for further analysis. Firstly, to continue discovering potential links between team roles and speech acts, we should look for speech acts patterns which may be specific to some team roles using sequence analysis. Secondly, we should deepen our analysis to try to identify if speech acts and some specific team roles are linked to successful collaboration, and we consider giving instruction in discourse practices as McNair et al.(2010) did, but which would depend on the role of each team member to support successful collaborations. We must also broaden our research considering different age groups, which can impact speech acts during collaboration. Moreover, if future works confirm more links between speech acts and Belbin's team roles, we can imagine detecting team roles by analyzing team members written discourses to explore automatic group formation or to define role rotation between team members to develop skills needed for group work (De Wever & Strijbos, 2021).

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