The 12th International Conference on Computer Supported Collaborative Learning
Philadelphia, Pennsylvania, June 18-22, 2017

# Examining Positive and Negative Interdependence in an Elementary School CSCL Setting

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**Abstract:** Social interdependence is a key concept in CSCL research. However, investigations of students' positive and negative interdependence during collaborative activities have often relied on self-report, rather than dialogue analysis. Bringing together politeness and social interdependence theory, we assessed *dialogue indicators* of positive and negative interdependence from behavioral data (namely, face-saving and face-threatening dialogue moves) and compared the results with those of self-report scales. We analyzed a data set of 30 elementary students learning fractions with an intelligent tutoring system (ITS). Our initial analyses focus on the link between use of language that is face-saving (e.g., marking identity with statements such as "we are great") or face-threatening (e.g., insulting), and students' preferences to collaborate and compete. We found only non-significant correlations between these two broad categories, but found significant correlations between dialogue indicators, such as the use of identity markers and joking, that suggest directions for subsequent studies.

## Introduction

A major predictor of how students are learning collaboratively is the dialogue that occurs within a group. Often dialogues are analyzed for the cognitive aspects of the collaboration while ignoring the social interactions that are occurring between students. However, in previous studies, in which the social aspects are analyzed, they have been found to play a significant role in the student collaboration (Wang et al., 2008; Ogan, Finkelstein, Walker, Carlson, & Cassell, 2012). In CSCL research, social aspects often address types of interdependence among interacting students. As a key concept of CSCL research, social interdependence describes the relationship between students, which can be either collaboratively or competitively (Johnson & Johnson, 2014). Whereas collaboration belongs to positive interdependence, because the success of interacting students is positively related, competition describes a situation, in which the students' chances to succeed are negatively related (Johnson & Johnson, 2014). Investigations of social interdependence have often been limited to investigating positive interdependence between students without investigating the impact of negative interdependence on student learning. In our paper, we propose to analyze the dialogue between students to understand how both positive and negative interdependence correlate with the students' self-reported approach to group learning and their learning gains.

Positive and negative interdependence are defined within the social interdependence theory, which provides a lens for exploring the social dimension of student collaboration (Johnson & Johnson, 2014). To achieve positive interdependence within a group, the collaborative task must be structured in a way that only allows students to succeed if all group members succeed (Johnson & Johnson, 2014). However, students do not always approach the task in a collaborative manner and may instead view it as a competition. Competition can lead to negative interdependence between students. In this state the success of one student depends on the failure of another (Johnson & Johnson, 2014). Thus, negative interdependence will likely inhibit collaborative behaviors.

Within computer-supported collaborative learning (CSCL) research the impact (or possibility) of negative interdependence often has been neglected. Additionally, learning environments are assumed to foster positive interdependence among students without checking if positive interdependence was indeed achieved (Olsen, Aleven, & Rummel, 2016). More generally, within the field of CSCL, there has been little research on *behavioral indicators* of positive and, in particular, negative interdependence and how it relates to learning. Most studies that measure interdependence rely on students' self-reports about their behavior during the learning phase (Myake & Kirschner, 2014) or their preferences for working collaboratively or competitively (Johnson & Norem-Hebeisen, 1979). However, as self-reports do not necessarily reflect the actual interactions that occurred during the learning activity, exploring additional indicators of positive and negative interdependence by studying the student dialogue may offer new theoretical insights into the process of collaborative learning.

Politeness theory (Brown & Levinson, 1987) is potentially highly valuable for extending research on positive and negative interdependence as both forms of interdependence often reveal themselves through the language and word choice that students use in their communication with each other. Politeness theory stipulates that individuals have a need of being appreciated as a valued member of a group (Brown & Levinson, 1987). To achieve this, individuals avoid excluding statements and actively respect or 'save' another person's face by using politeness strategies. Based on politeness theory, one could expect that collaborating students often attempt to save each other's face. For instance, when students use words that indicate they are part of the group – identity markers, such as 'we' – the face of other group members may be enhanced because they see themselves as respected within the group. If there is positive interdependence among students, the importance of face-saving behavior potentially increases since the students need (or want) to succeed as a group. On the other hand, if a student insults the abilities of another student then there is a threat to that student's face, and an active dissociation from the group identity could be assumed. Such face-threatening behavior may result from negative interdependence among students because competition goes along with discrediting the 'opponent' to strengthen one's own position. By analyzing the face-saving and face-threatening behavior that are used within the student dialogue, politeness theory can help to analyze social interdependence within the dialogue. Specifically, face-saving strategies (e.g., using an identity marker, making jokes, laughing) can be associated with positive interdependence whereas face-threatening strategies (e.g., insulting, swearing, disagreement) can be associated with negative interdependence.

In this paper, we analyze the dialogue data collected during elementary school students' use of a collaborative intelligent tutoring system (ITS) (Olsen, Aleven, & Rummel, 2016) to explore how students' self-reported preferences for working collaboratively or competitively are associated with dialogue strategies used during learning that focus on face-saving and face-threatening strategies. By bringing together politeness and social interdependence theory, we developed and tested indicators of positive and negative interdependence with students' dialogue data and compared it with self-reported scales of students' collaborative and competitive preferences. This explorative research extends existing studies of social interdependence within CSCL by investigating students' communication directly and comparing it with self-reported data, which is typically used. We hypothesize that face-saving strategies positively correlate with collaborative preferences and face-threatening strategies positively correlate with competitive preferences.

## Methods

For our analysis, we used dialogue transcripts of $N = 30$ collaborating elementary students (15 dyads). The data was from a study investigating 4th and 5th-grade students who worked collaboratively with an ITS (Olsen, Aleven, & Rummel, 2016). The learning phase took place on three 45-minute days with the students' knowledge measured at pretest and posttest on two additional days. Within our analysis, we only included students who completed all learning phases with the same partner. The students either worked on a conceptually or procedurally oriented tutor that focused on naming, making, equivalent, least common denominator, as well as comparing, adding, and subtracting fractions. During the time with the ITS, students sat next to each other and thus were able to communicate directly. The tutors supported synchronous, networked collaboration through embedded collaboration scripts, in which collaborating students had a shared view of the problem state with different actions and information (task and resource interdependence) available on each of their computers. The scripts were designed to support positive interdependence through a distribution of responsibility. For instance, students had some actions that only they (and not their partner) could take. Students therefore needed to collaborate since they did not have access to all necessary information and actions to solve the problem successfully on their own. However, we do not certainly know if the scripts stimulated positive interdependence among the students.

### Self-reported Preferences for Collaboration and Competition

To measure students' preferences for working collaboratively or competitively, we used two scales developed and tested by Johnson and Norem-Hebeisen (1979). In these scales, indicators of collaborative preferences include a tendency to help other students, to share ideas and materials, or to consider supportive behavior. In contrast, students with competitive preferences prefer to 'be better than others' or to 'challenge who is best' (see Johnson & Norem-Hebeisen, 1979 for more information). The collaboration scale (i.e., cooperation in Johnson & Norem-Hebeisen, 1979) consisted of seven questions, whereas the competition scale consisted of eight questions, which were measured on a seven-point Likert scale. All students completed both scales.

## Examining Politeness Strategies and Face Attacks from Dialogue

We analyzed transcripts of the students' dialogue for all three days the students worked with the ITS. Based on politeness theory, we identified several *face-saving behaviors* (i.e., identity markers; compliments; agreements; encouraging participation; joking statements; laughing) and *face-threatening behavior* (i.e., insulting; disagreement; preventing participation; swearing). Within the students' dialogues, each of the statements was coded for these behavioral codes, and multiple codes could be applied to each statement. For instance, a single statement could include laughing, identity marker as well as insults. After coding the transcripts of the first day, we tested the inter-rater-reliability to decide if coding with all categories would be suitable. Because Kappa statistics was low for the most behavioral codes, we coded the subsequent days with only the three variables for face-saving and –threatening behavior that had the best Kappa statistics. These categories included: *identity marker, laughing, joking statement, insulting, disagreement*, and *swearing* (see Table 1 for the Kappa statistic). In the following, we briefly explain the categories we used for our analysis of the students' dialogues. For save-saving behavior, we concentrated on *identity makers*, *laugh as a reaction* and *joking statements*. *Identity markers* include the use of words like 'we' which highlight group identity. If students *laugh as a reaction*, they might foster group cohesion or have a close relationship, in which positive interdependence is naturally given. In addition, contributing *joking statements* to cause amusement or laughter can increase (or indicate) group cohesion. For face-threatening behavior, we focused on *insults*, *disagreement* and *swearing*. In contrast to face-saving behaviors, *insulting* someone (e.g., 'you suck') might attack cohesion between students. The same may be true for *swearing* and *disagreeing*, whereas *disagreement* also might express constructive criticism that contributes to a collaborative approach to solving the problem. However, politeness theory defines the expression of disagreement as well as insulting and swearing as a rude behavior as it is attacking the another person's face.

## Findings

We correlated the face-saving and -threatening behavior, the collaboration and competition scales by Johnson and Norem-Hebeisen (1979), and the students' learning gains from pre- and posttest (see Table 1). We did not find a significant correlation between any of the variables and learning gains. However, there was a significant, negative correlation between students' preferences to collaborate and their preferences to compete ($r_S$ = -.41, $p$ < .01). Within the behavioral indicators, we found a significant correlation between the use of identity markers and joking statements ($r_S$ = .61, $p$ < .01) and between showing disagreement and insulting a partner ($r_S$ = .67, $p$ < .01). We found no significant correlations between any of the remaining variables. Nevertheless, as highlighted in *Table 1*, we found – even if not significant – moderate negative correlations for all face-attacking variables with preferences to collaborate, as well as moderate positive correlations between these variables and preferences to compete.

Table 1: Spearman's rho coefficient and Kappa statistics

| | | Kappa | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Learning Gain (Pre-Post) | | | | | | | | | |
| 2. | Competition Scale | | -.24 | | | | | | | |
| 3. | Collaboration Scale | | .14 | **-.41*** | | | | | | |
| 4. | Identity Marker | .65 | -.20 | .23 | -.16 | | | | | |
| 5. | Laughing as Reaction | .85 | -.07 | -.06 | .17 | .16 | | | | |
| 6. | Joking Statement | .54 | -.08 | .32 | -.11 | **.61*** | .26 | | | |
| 7. | Insulting a Person | .45 | -.07 | **-.22** | **.21** | .19 | -.11 | .34 | | |
| 8. | Disagreement | .41 | .02 | **-.19** | **.13** | .22 | -.06 | .24 | **.67*** | |
| 9. | Swearing | .57 | .19 | **-.23** | **.31** | .10 | .33 | .35 | .30 | .35 |

## Discussion

Our explorative analyses examined the link between face-saving statements (e.g. using identity markers, making jokes, laughing) and face-threatening statements (e.g. insulting, swearing, disagreement) and students' preferences to collaborate or compete. By bringing together politeness and social interdependence theory, we developed and tested indicators of face-saving and -threatening actions to compare coded dialogue data with self-reported scales. We hypothesized that face-saving strategies positively correlate with collaborative preferences and face-threatening acts positively correlate with competitive preferences. Although we found a negative correlation between the competition and collaboration preference scales indicating divergent validity,

the data provides no evidence for our hypotheses regarding the alignment of the face-saving and face-threatening strategies with the self-reported scales. Interestingly, there was a significant positive correlation between the use of identity makers and joking statements. Thus, students, who make more jokes also tend to use more group identity markers such as "we" or "us". One could argue that joking occurs especially when students have already established a good relationship and thus feel more group identity and social cohesion, which in turn could be represented by the use of identity markers. Conversely, if students do not have a common ground or a close relationship, as could be indicated by a low frequency of identity markers, they likely do not make jokes. In addition, we found a significant positive correlation between insulting the partner and showing disagreement, which is of particular interest for research on younger students. It could mean that elementary school students tend to express disagreement or a conflicting point of view by using face-threatening behavior such as insulting.

Surprisingly, we found positive, even though non-significant correlations for face-threatening dialogue behaviors and collaborative preferences of the students and, conversely, negative, non-significant correlations between these same dialogue behaviors and competitive preferences. This finding aligns with results of Ogan et al. (2012), who showed that insulting (or rudeness) can be an expression of rapport between students and may lead to higher learning gains. Thus, one could argue that face-threatening behavior indicates collaboration (or at least, a desire or tendency to collaborate). Students who want to collaborate may not have the abilities to do it appropriately, especially in this young age group. This explanation also is consistent with the fact that insulting correlates with disagreement, as younger students might not know how to disagree with each other's ideas without being rude and using insults. For subsequent analyses, we may have to rethink our hypotheses.

However, using politeness theory to investigate student dialogue provides some challenges. A major hurdle in analyzing student dialogue based on politeness theory is understanding how a certain message was intended to be interpreted and how it indeed was interpreted by the addressed student. An insult, for instance, can either be a face-threatening behavior with the intention to harm someone, or it can express friendship between students, whose relationship is strong enough to endure rudeness. Further studies may focus on more qualitative analyses of dialogue to figure out in more detail how students (co-)construct their relationship within this CSCL setting. Continuing analyses with more qualitative methods could lead to a deeper understanding of how social interdependence manifests itself in dialogue. Furthermore, in learning environments that aim to foster interdependence among students, one could expect that the learning outcomes (or success) of students in the same team are positively related. To analyze in more detail how students treat each other depending on their preferences to collaborate or compete, the form of interdependence within the learning situations, and the effects on their learning outcome could be an interesting direction for future research in CSCL.

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## Acknowledgments


This work was supported by Graduate Training Grant #R305B090023 and by Award #R305A120734 from the US Department of Education (IES).