The Interaction between Cognitive and Motivational Co-regulated Processes on a Collaborative Task

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Abstract: Co-regulated learning (CRL) describes the social processes group members employ to regulate their shared work on a joint task (Vauras et al., 2003). Research has suggested that effective CRL is a characteristic of successful collaborative groups and that effective collaboration is associated with higher performance on tasks and positive social outcomes (Roschelle & Teasley, 1995). While recent research has certainly added to our understanding of CRL, most studies have focused on either co-regulation of cognitive (e.g., planning, monitoring, evaluation) or motivational (e.g., efficacy, attributions) processes ignoring the interaction between these processes. Using a socio-cultural framework (McCaslin, 2004), this study built on the extant literature by describing cognitive and motivational instances of co-regulation within two, sixth grade collaborative groups (N=8) and then explaining how these processes inter-related and co-occurred. Video transcripts (N=18; 2,880 minutes) of group interactions over 9-weeks served as the data for this analysis. Following coding procedures used by Volet et al. (2009) and Wolters, Pintrich and Karabenick (2005) the data were categorized by type (other vs. shared) and regulatory process (cognitive vs. motivational). Using standard qualitative methods (Creswell, 1998) a cross-narrative analysis was constructed to describe instances of cognitive and motivational co-regulation and to discuss their relationship. Results of the analysis indicated that agreement and interest led to sustained co-regulation of cognitive processes, while verbal put-downs thwarted it. Understanding how cognitive and motivational processes co-occurred and interacted not only adds to our understanding of CRL, but can be used in practice to improve how peers work effectively within the collaborative context.

Keywords: Co-regulation, Collaboration

CO-REGULATED LEARNING (CRL) describes the social processes group members employ to regulate their shared work on a joint task (Vauras, Iiskala, Kajamies, Kinnunen & Lehtinen 2003). For example, peers may mutually set goals and plan strategic approaches to the problem; coordinate multiple goals and ideas; monitor task engagement, effort, or attention; or sustain engagement through positive talk and support (Patrick & Middleton, 2002). Research has suggested that effective CRL is a characteristic of successful collaborative groups and that effective collaboration is associated with higher performance on tasks and positive social outcomes (Roschelle & Teasley, 1995; Johnson & Johnson, 2004). While recent research has certainly added to our understanding of CRL, most studies have focused on either co-regulation of cognitive (e.g., planning, monitoring, evaluation) or motivational (e.g., efficacy, attributions) processes ignoring the interaction between these processes (e.g., Järvelä & Järvenoja, in press; Volet, Summers & Thurman, 2009; Hurme & Järvelä, 2005). Using a socio-cultural framework (McCaslin, 2004), this study built on the extant literature by describing cognitive and motivational instances of co-regulation within two, sixth grade collaborative groups and then explaining how these processes inter-related and co-occurred. Understanding how cognitive and motiv-

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ational processes co-occurred and interacted not only adds to our understanding of CRL, but can also be used in practice to improve how peers work effectively within collaborative contexts.

Background

Socio-cultural researchers consider the social processes that underlie how learners acquire and use cognitive, motivational, and behavioral strategies to self-regulate. While individual theories of self-regulated learning (SRL) treat interpersonal, social, and/or cultural influences as separate variables that affect regulatory processes, social theories of regulation posit that SRL is fostered, developed, and maintained (1) within social contexts and (2) as a result of interactions among peers. Fundamental to socio-cultural approaches to SRL is the concept of co-regulation. Co-regulation can vary from *other* regulation to *shared* regulation depending on the relationship between group members (Vauras, Iiskala, Kajamies, Kinnunen, & Lehtinen, 2003). If a more regulated peer (MRP) assumes responsibility for regulating a less regulated peer (LRP) co-regulation is *other* regulated. Alternatively, when regulation activities are assumed by two or more group members simultaneously, co-regulation is *shared*.

Several examples from the literature can be used to illustrate different forms of co-regulation. For example, Patrick and Middleton (2002) described an instance during a global warming unit in which a MRP co-regulated a LRP. As students worked in groups to explore issues related to colors and heat absorption one group member asked "why deserts are hotter than rain forests, even though the yellow sand is a lighter color than the green vegetation of rain forests" (p. 32)? Several hypotheses were offered by different group members including: there are no clouds over the desert to reflect the heat, certain minerals found in sand cause more sunlight to be reflected, and the greenhouse effect is absent overhead. Marius, who suggested the final hypothesis, offered numerous explanations to support his reasoning. Monitoring Marius' reasoning, however, another group member co-regulated Marius' learning by helping him to realize an error in his argument (i.e., there is a greenhouse effect around the whole earth so why not the desert). The authors' concluded that this caused Marius to re-evaluate his initial assumptions, and as a result he rejected his own hypothesis. Because another group member assumed responsibility for monitoring and evaluating Marius' understanding this example can be categorized as other-regulation.

Shared regulation, on the other hand, is when multiple group members jointly assume responsibility for regulation activities. This concept is conceptually similar to co-construction of knowledge (Vauras et al., 2003). For example, Vauras et al. (2003) examined high-ability fourth-grade students' shared regulation as they worked collaboratively on mathematical problems in a computer-supported gaming environment. Investigating both individual and social processes, the researchers found that effective reciprocal shared regulation led to high-quality learning, use of deep-level strategies, and transfer (i.e., cognitive co-regulation). Furthermore, the authors noted that the type and quality of shared regulation observed related to the nature of task at hand. Similarly, research by Järvelä & Järvenoja (in press) suggested that groups of college-aged students socially constructed motivation as they employed shared motivational co-regulation strategies (e.g., social reinforcement, task structuring) during a collaborative educational psychology task and that this helped them control task-specific social challenges.

Although co-regulation has potential academic and social benefits, research by Kempler & Linnenbrink-Garcia (2007) who investigated shared regulation among sixth grade students working collaboratively on a mathematics unit, found that although both groups frequently employed strategies to regulate each other's cognition and behavior, the quality of these processes were predominately low-level and not sustained for long periods. This pattern was also found in research by Hurme & Järvelä (2005). In response to these findings, Volet, Summers & Thurman (2009) have investigated cognitive strategies that led to high co-regulation and factors that appeared to contribute to sustaining high co-regulation in three second-year university veterinary science student groups. The authors suggested that posing questions (direct or implied), offering an explanatory statement or summary, or implying a suggestion were common patterns that contributed to high cognitive co-regulation among group members. Additionally, high co-regulation was sustained through question-asking; tentativeness; background knowledge; and shared positive emotions.

Thus, using a socio-cultural framework and building on the extant literature on co-regulated learning processes in collaborative groups, the current study addressed the following research questions. First, how often do group members engage in co-regulated motivational and cognitive processes during this collaborative, authentic task? Second, what is the relationship between co-regulated motivational and cognitive processes?

Method

Sample

Participants included 8 middle school students (age range, 11-12) from a large urban gifted and talented (G&T) kindergarten through eighth grade school in northeastern United States. Students applied to the G&T program during first grade based on their academic, artistic, performing arts, *or* athletic abilities. Therefore, students were not necessarily academically gifted. The racial and ethnic composition of the school reflected the larger diversity of the district in that 64% of students were Hispanic, 25% of students were African American, 10% of students were Caucasian, and 2% were Asian. 77% of students were eligible for a free or reduced price lunch program, which was consistent with the district average. The state average, however, was 27%.

Description of Group Projects

Students worked collaboratively to design and carry out a cross-disciplinary project that included the features of high-self-regulated learning tasks described in the literature. These include tasks that are personally meaningful, collaborative, and provide opportunities for autonomy and self-and peer evaluations (see Perry et al., 2002 for a review). In this project, students were afforded many opportunities to make choices that included selecting a topic and planning how to solve it. This required students to routinely engage in decision-making processes in order to regulate their use of time and resources effectively. Tasks were designed to be meaningful by allowing students to explore topics that were of interest to them and that were authentic (see Brown, Collins, & Duguid, 1989). Finally, there were multiple opportunities for students to engage in self- and peer evaluations of their plans, processes, and products. Teachers acted as facilitators to help students focus their areas of interest, formulate

a plan, model appropriate information seeking strategies, and assess their projects. Ultimately, however, the responsibility for a successful project lied with the students. While the nature of the task allowed for a variety of projects, all projects included these underlying high-SRL task features.

The dinosaur group. Group 1 (2 males, 2 females) was interested in learning about dinosaurs and decided to research various dinosaurs in the late Jurassic period in order to design a new wing for the Museum of Natural History. To gain a real-world perspective, the group contacted the Director of Education for the Museum of Natural History, who provided them with information on the process researchers, scientists, and interior designers use to construct a new wing. Students also used diagrams from the museum's website as well as information about the size of NYC blocks to calculate the dimensions of their wing. Next, after a discussion regarding the most efficient and logical layout designs, students agreed to group dinosaurs by geographic region. Last, the group used ratios to make a scaled model of their new wing, along with educational activities to help visitors learn more about Jurassic era dinosaurs.

The car group. Group 2 (4 males) determined that they had a shared interest in cars and sculptures and decided to design an energy efficient sports car that relied on solar and hydrogen energy to power the car as opposed to gasoline. To design their car, first they researched the parts of a gasoline powered sports car (e.g., structural features, safety features, design elements) and how gas moves through the engine to power the car. Next they learned more about solar and hydrogen energy to determine if these energy sources could be used to power their car and if so, how each of these processes operated. For example, while researching solar energy, they learned that their car would need to be made of high-grade steel in order to withstand high temperatures and also which types of solar panels were most efficient for harvesting solar energy. They also researched how hydrogen and solar power could be converted into electricity to power their car. Finally, they investigated the environmental benefits of using solar and hydrogen energy sources. All of this information was combined to construct both external and internal designs of their energy efficient sports car and to create a mission statement for their company.

Procedure

This research was part of a mixed methodological study that included quantitative measures as well as a larger sample size. Students not participating in the school band were eligible to be part of this study and were randomly assigned to one of four classrooms. In order to ensure group members would be able to agree on a common project topic, students were assigned to groups based on their interests in mathematics, language arts, science, performing arts, or writing. These groupings were based on an interest questionnaire the school distributed at the end of the previous school year. Classes met for 45-minute a day, five days a week over a nine-week period.

Teachers collected consent forms in January during regularly scheduled classes. Students who obtained parental consent were eligible to participate in this study. In order to build cohesion and interdependence among group members before they began to design their projects, students participated in a series of daily team building exercises (see Cohen, 1994 for a description). During week two, students created a group collaborative collage. The goal of this exercise was to help group members identify shared interests. This resulted in the identification of one or two themes that all members agreed that they would like to base their

projects. A group binder was also distributed during week two. Each binder contained a number of materials to help structure the development of their project. The materials were intended to (1) ensure that group members could describe their projects in narrative form, (2) help students identify their learning goals for their project, and (3) serve as a record of their short and long term plans. Daily, weekly, and monthly calendars were also included in their binders to help group members manage their projects. These materials were given to students in their group binder so that they would have a place to store all information related to their project.

Data Analysis

Video transcripts (N=18; 2,880 minutes) of group interactions over 9-weeks served as the data for this analysis. The process began by constructing summaries of the group members conversations and behavior for every fifteen minutes of tape, which were defined as an episode. Discourse within an episode that reflected on-task behavior was transcribed verbatim along with descriptions of students' nonverbal behavior. All of the data were coded with Nvivo software program for qualitative research in order to organize, cross-reference, and synthesize the data. Following coding procedures used by Volet et al. (2009) and Wolters, Pintrich and Karabenick (2005) the data were categorized by type (other vs. shared) and regulatory process (cognitive vs. motivational). After an initial round of coding ensued, the coding scheme was slightly modified to include more specific processes within the cognitive domain (See Table 1). Another researcher coded 20% of the transcripts in order to establish reliability, which was 84%. After discussion agreement was reached on all codes. Next, using standard qualitative methods (Creswell, 1998) a cross-narrative analysis was constructed to describe instances of cognitive and motivational co-regulation and to discuss their relationship. When identifying themes the data were examined for negative instances of potential patterns or alternative explanations that could help interpret the findings.

Results and Preliminary Discussion

Consistent with the research questions, the relationship between cognitive and motivational processes was explored by (1) identifying the percentage of utterances of cognitive and motivational co-regulatory processes within both groups and (2) describing patterns of interaction and co-occurrence between those co-regulatory processes.

Instances of Co-regulated Cognitive and Motivational Processes

The first way to examine the relationship between co-regulated cognitive and motivational processes was to investigate the percentage of these utterances across both groups over the course of the project. As shown in Table 2, both groups spent the majority of their cognitive regulatory activities content monitoring and process planning. Recall that content monitoring referred to instances when group members co-regulated each other's ideas, research, and/or problem-solving related to the content of their projects. These activities occurred 36% of the time in the dinosaur group and 31% in the car group. Process planning, which described instances in which group members assigned each other group roles or decided the order in which tasks should be completed, was also high in both groups (28%, dinosaur, 29%, car).

One potential reason why both groups engaged in numerous instances of content monitoring and process planning was because they spent considerable amount of time during the start of the project proposing, refining, and agreeing on a project idea via product planning (15%, dinosaur; 14%, car). Students' efforts to co-regulate their product planning potentially led to the development of intersubjectivity and a shared goal for the overall project (Rogoff, 1990). Once group members had a shared understanding of the goals of their project, then they were able to delegate who would carry out the various tasks of their project, and what order they would complete tasks (i.e., process plan). Once assigned a task, group members were able to begin researching content related to their projects, which created opportunities for them to monitor each others' progress (i.e., content monitoring).

Overall there were few instances in both groups in which individuals co-regulated evaluation processes. In general the literature on evaluation processes has suggested that students do not engage in these processes frequently, in part because they lack appropriate knowledge of various evaluative strategies and specific criteria on which to evaluate other members' contributions (Abram, Scarloss, Holthuis, Cohen, Lotan, & Schultz, 2002). It is also possible that because students did not begin evaluating each other's work until the end of the project period, there was less time available for students to engage in co-regulated evaluation processes.

Turning now to how group members co-regulated motivational processes, Table 2 indicates that both groups relied on statements that expressed how interesting or cool an idea (or aspect of the task) was as a way to co-regulate motivation over the course of the project (58%, dinosaur; 83%, car). Recall that one of the goals of the project was for students to create a group project that incorporated the group members' individual interests. Research by Ainley, Hillman, and Hidi (2002) found that secondary literacy students with higher individual interest in reading experienced greater interest in reading tasks, showed more persistence, and scored higher on performance measures. Thus, one possible explanation for the high number of instances of interest statements was that students were personally interested in the topic and this was expressed in their discourse. Although one might expect individual interest to correlate with situational interest, there was little guarantee that every group member's personal interests would be included in the group project or that personal interests would remain the same over the course of the project. Although less often than statements expressing interest, individuals from both groups also regularly made statements that signified agreement or understanding (17%, both groups).

Interaction between Co-regulated Cognitive and Motivational Processes

A second way to understand how group members co-regulated cognitive and motivational processes was to examine patterns of interaction between these processes. While examples of student discourse reflecting cognitive and motivational instances of co-regulation are described in the literature (e.g., Vauras et al., 2003); how these processes interact and co-occur within the collaborative context has been given less attention. The results of the analysis indicated that instances of cognitive and motivational co-regulation co-occurred as students engaged in their group projects. Furthermore specific motivational regulation processes (e.g., statements that expressed interest or agreement) appeared to help sustain co-regulated cognitive activities, while incidents of verbal put-downs had the opposite effect.

Expressing interest was one type of motivational regulation strategy that helped sustain group members' co-regulated cognitive activities. In general, interest supported co-regulated cognitive efforts by establishing intersubjectivity which led to further co-regulated cognitive activities. For example, in the car group while cutting out pictures of cars for their collaborative collage, the group members began to define their project by product planning what type of car they intended to design. The text in italics has been added to direct the reader's attention toward the salient points of the interaction.

Nate—Group: We're going to make, guys we're going make like our own kind of car I guess, right? *(initial idea proposed by one group member)*
Rick—Nate: Well, we have to agree on something, all together.
Nate—Rick: But I'm saying we should make like our own car *(the idea is elaborated on)*
Barry—Nate: But not a regular car— like one that uses solar or some other energy *(the idea is elaborated on and refined by another group member)*
Nate—Group: so like an energy efficient car *(the idea is summarized for the group)*
Barry—Group: it could be… like… an energy-efficient Honda *(another idea is proposed but it is an extension of the original project idea)*
Adam—Group: hey how about a sports car
(the idea is refined by another group member)
Nate—Group: an energy efficient sports car…cool! *(the idea is summarized for the group) (regulates motivation by expressing interest in the topic)*

When students expressed interest it supported cognitive co-regulation in that it communicated approval of the proposed idea and established intersubjectivity. For example, Nate indicated that the idea of designing an energy efficient sports car was "cool" which communicated understanding and acceptance of the proposed idea. This led to further cognitive regulation processes via process planning.

Adam—Group: ok, so cut vehicles, cut out any sports car vehicles. (*a direction is given for how to proceed toward accomplishing the project idea, this is the beginning of process planning*)
Barry—Adam: I think I saw some in here (*grabbing a magazine on vintage cars*)
Adam – Barry: This is going to be….awesome (*regulation of motivation – interest*)
Barry – Nate: I know…hey why don't you look in this one (*passes Nate a Men's Health magazine) while we (referring to Adam and himself*) look through…. (referencing the magazine he chose before)
Adam – Barry: Oh cool! Check this one out…look at the fins off the back
Rick – Adam: Nice, we can put those on our car. Here (*passing Adam the scissors*) cut it out.

Notice how statements conveying interest co-occurred with co-regulated cognitive activities (e.g., "this is going to be awesome" and "Oh cool" with process planning). This potentially served to sustain process planning activities by motivating group members to remain on task. While it is possible that planning would have continued regardless of whether group members expressed interest in a particular idea, it is also possible that without such social

reinforcement group members would have abandoned their ideas. It appeared statements intended to convey interest promoted continued planning processes by acknowledging the merit of a proposed idea and communicating intersubjectivity.

Expressions of interest were potentially even more important to sustaining cognitive regulation activities when group members' were tentative about a proposed product or process plan. In the following excerpt from the dinosaur group, the group members discussed the specific goals of their project. In an earlier episode of product planning, the group had established that their project would entail designing a new wing for the Museum of Natural History.

Terri – Group: Okay, so somebody has to start writing the goals. What are our goals going to be?
Jake – Group: Ok wait, my turn, my turn. (*Tries to take the binder from Cathy who is writing in it*)
David – Group: What are we gonna learn from this project?
Terri – David: The goals are to learn more about prehistoric dinosaurs.
David – Terri: Wait…isn't it learning about the museum…
Jake – Group: how to make a wing in natural history museum or something like that.
David – Group: Yes, Yes, Yes that is it… cool…write (*To Cathy)*
David – David: Oh man I need a better pencil…this is (*Unintelligible*)
Terri – Cathy: (*Whispers to Cathy who has the group binder*) are you almost done?
Jake – Cathy: No. Wing. (*indicating to Cathy what to write)*
12:27
David – Terri: Do you have a pencil?
Terri – Jake: yes I have a pencil…here. What do you mean about how to make a wing?
Jake – Terri: like where to put stuff, like maybe we could have things to do in the wing…um find out about what goes in the wing
David – Terri: Thanks (*to Terri for the pencil)*
Cathy – Terri: I want to do Terri's idea. That one is the best.
Jake – Cathy: What?
Terri – Jake: We want to learn more about prehistoric dinosaurs
Jake – Terri: Oh yeah, that would be good…put that too.
Jake – Cathy: OK come on. My turn. My turn. My turn. My turn.

In this excerpt of product planning members of the dinosaur group decided on the specific goals of their project. Again notice how expressions of interest co-occurred while group members engaged in product planning. For example, Jake's proposed plan to specify learning about how to make a wing for the museum was followed by David's response that this was an interesting idea (e.g., Yes, Yes, Yes that is it… cool…write). This proposed plan was then integrated into the group project by Cathy recording it in the group binder as one of the group's goals. Terri's proposed idea regarding learning more about prehistoric dinosaurs was not included in the group's plan until Cathy (later in the episode) expressed interest in it. Thus, it appeared from the group discourse that acceptance (indicated by interest) was a contributing factor in whether a proposed idea was further elaborated on and eventually incorporated into the group's goals.

Statements made by group members to express agreement with another group member also appeared to sustain cognitive regulation processes in these groups. For example, in this

next excerpt, members of the dinosaur group shared in co-regulating product planning. This discourse occurred during the first week of the project after students had finished putting together their collaborative collage and were attempting to decide on a project idea.

Jake – group: I like it. *(Jake is referring to the idea of doing a project about dinosaurs)*
Terri – group: So do I (*regulating motivation, agreement)*
Jake – group: but okay.
Cathy –group: we could actually do like two ... *(Cathy is referring to an idea to do two models for two of the dinosaurs in their wing)*
Jake – group: Well like two of the exhibits could be on the same floor ..., like, me and Cathy's, Terri and David's, or me and Terri's, and David's and Cathy's, whatever. *(Jake elaborates on and refines this idea) (agrees with Cathy)*
Terri – group: You could just put the whole model of the wing. *(Terri offers an alternative idea)*
Cathy – group: We could do like two each. Like two exhibits in the wing *(Cathy tries to blend both project ideas together)*
Terri – Cathy: …we shouldn't do like both cause that's kind of too much. Cause you have to ...
Cathy – Terri: No but it's a museum. Museums have to be full of exhibits. There just can't be like four of them.
Jake – Terri: But we are only doing one wing. So we'll have one wing with a lot of exhibits
Terri – group: yea but like if we only have like 8 weeks then I don't think we can make up that many exhibits.
Cathy – Terri: Then what we have to do is like research a little bit of every dinosaur and like only show the exhibit for one ...
Terri – Cathy: Come up with the ... (*pushes hands out on desk*)
Jake – group: Or we research 3-4 dinosaurs each ...
Cathy – group: Ok, but only do one floor plan for the whole wing *(summarizes the idea) (regulating motivation, agreement)*

In this excerpt, a strategy typically associated with regulating motivation (i.e., agreement) also potentially contributed to sustaining cognitive regulatory processes (i.e., product planning). Similar to the role interest played in the previously discussed excerpts, statements conveying agreement communicated approval of a proposed idea and established intersubjectivity among the group members. Furthermore, statements of agreement served to sustain product planning activities by signifying to the other group member that the idea was valued even if that idea was to be further refined. For example, Jake agreed with Cathy's proposed project idea and then proceeded to refine it. Jake's expression of agreement may have signaled to Cathy that her idea was valued and should be included in the overall project even though he was suggesting it be modified. Because Cathy felt that her ideas were being valued by the group members she continued at product planning. Had Jake ignored Cathy's idea completely, it is possible that she would have disengaged from product planning processes.

Thus, statements that expressed interest or agreement served to establish intersubjectivity among the group members and potentially contributed to sustained regulation of cognitive activities. However, not all types of motivational processes affected cognitive regulation in

a productive way. When students expressed verbal put downs toward each other, this was associated with decreased co-regulated cognitive efforts.

Verbal put-downs, which referred to criticizing statements, accounted for 25% of the motivational processes used, and only occurred in the dinosaur group. Although they occurred less frequently than expressions of interest and agreement, when group members made criticizing statements it was associated with reduced co-regulated cognitive activity. One of these instances occurred when Cathy and Terri were working on figuring out the dimensions for their wing. Cathy asked Terri numerous questions about how she determined certain measurements. Eventually, Terri became frustrated with Cathy's questions and let out a loud sigh. David overheard this and stated, "Does she annoy you or something?" at which Terri replied, "Yes, she does…very much." This appeared to hurt Cathy's feelings as she put her papers in the binder and walked over to the desktop computers on the other side of the room where she remained for the rest of the period. While it was not possible to read the computer screen to determine if she was researching information related to the project or off task, it was clear that Terri's statement ceased the co-regulated planning activities they were engaged in.

Although it did not occur here, conceivably there are instances in which a verbal put-down could motivate behavior and lead to sustained co-regulation. For example, if student A and B were establishing a plan for a project, and student B rejected an idea that student A had with an insulting comment, it is possible that student A could defend her idea or propose a new one. The danger in students using criticizing statements while co-regulating is that they could potentially lead to diminished participation or complete withdrawal from the task at which point co-regulation inevitably ceases (as was the case in the dinosaur group). In this research, in each instance in which a group member was criticized by another group member, it resulted in that group member temporarily withdrawing from the co-regulated activity. As such, instances of verbal put-downs were considered unproductive to co-regulated efforts.

Discussion and Conclusion

The purpose of this research was to examine co-regulated instances of cognitive and motivational processes and to investigate how these processes co-occurred within collaborative discourse. By examining the frequency of students' co-regulated efforts, the data suggested that both groups spent the majority of their cognitive regulatory activities content monitoring and process planning. One potential explanation for this finding was that both groups established intersubjectivity through detailed product planning. Once group members had a shared understanding of their project, then they were able to engage in process planning and content monitoring (of their project ideas). While intersubjectivity has been cited as important to cognitive engagement and productive collaboration (Cohen, 1994), this research extends this finding by suggesting that intersubjectivity may support co-regulated cognitive activities as well. While further research with a larger sample size will be needed to verify these results, the implication of these findings is that instruction or scaffolding to help group members establish intersubjectivity may help sustain their co-regulated activities in the group.

The second analysis suggested that statements that conveyed interest and agreement appeared to sustain cognitive regulation activities. Research in this area has already established the relationship between statements of interest and agreement and sustained motivation and cognitive engagement (Hidi, Renninger, & Krapp, 2004). For example, Hidi and Ainley (2008) found that as "interest developed it became a predisposition to engage with content"

(p. 77). Furthermore, interest correlated positively with attention processes, the quantity and quality of learning, and choice of motivation goals and strategies (Ainley, Corrigan, & Richardson, 2005). This research extends these findings by suggesting that these processes have the potential to sustain cognitive regulation activities as well. Because the data suggested that interest and agreement sustained motivation by establishing intersubjectivity one implication of this research is that preparing students for group work (Webb & Weishaupt, 1998) should include efforts to instruct them on the importance of verbalizing their interest and agreement (when appropriate) and how to do so productively. King (1992) and Wong, Lawson, and Keeves (2002) successfully used instruction to improve students use of questioning and self-explanations (cognitive processes documented by Volet et al., 2009 to lead to high level co-regulation). Thus, there is potential for instruction to lead to better and more frequent use of interest and agreement statements and as such improve how peers co-regulate effectively within collaborative contexts.

Table 1: Coding Scheme

Regulatory Process	**Definition**	**Example**
Cognitive	*Product Planning* Product planning involved defining the scope of the project and identifying its goals. *Process planning* Assigned group roles or decided the order in which they would complete tasks relating to a project idea	"We're going to make, guys we're going make like own kind of car I guess. Right?") "Nobody has done this. Do the products. Do el products, do products."
	Task Monitoring Monitored the status of the tasks created through process planning *Content Monitoring* Monitored each other's ideas, research, and/or problem-solving related to the content of their projects	"Who is researching stegosaurus?" "Wait, what did you have? What do you have on players' stats in there?"
	Content Evaluation Statements aimed to assess or judge content related to their project *Mechanics Evaluation* Assessing and correcting formatting, spelling, grammar, or punctuation errors	"Alright, you just need to like you don't need a second outline this one is fine the way it is." "No, that's not a word. It's worse"

Motivational	*Agreement/ Understanding* Statements to express agreement or understanding *Interesting* Statements to express how interesting or cool an aspect of the task was *Verbal Putdown* Criticizing statements	 "I get you." "That is so cool" "You suck, you know."

Table 2: Percentage of Utterance of Verbal Interactions Displayed by Two Groups Over Nine-weeks

	Group 1 (% Utterances)	**Group 2 (% Utterances)**
Cognitive Processes		
Product planning	15	14
Process planning	28	29
Content Monitoring	36	31
Task Monitoring	14	18
Content Evaluation	5	4
Mechanics Evaluation	2	4
Motivational Processes		
Agreement	17	17
Interest	58	83
Verbal Put-Down	25	0

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Dr. DiDonato is an Assistant Professor at Montclair State University in New Jersey, USA. Her research interests include examining how peers can potentially support the development of each other's self-regulated learning through co-regulated efforts on collaborative tasks. Dr. DiDonato has also published research investigating teacher-supports and task characteristics that sustain and develop students' self-regulation in middle school classrooms.

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