Group Emotions in Collective Reasoning: a Model

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1. Introduction

In recent decades, education research has gone through two major theoretical shifts: the extension of the concept of cognition from an individual to a collective, socio-cultural perspective, with the emergence of research on 'group cognition' (Stahl, 2006), and the inclusion of the affective dimension of learning, with the emergence of a view on cognition which does not separate emotions from reason. Recently, Baker, Järvelä and Andriessen edited a book, *Affective Learning Together* (2013), which is emblematic of this renewed conception of learning processes. The emergence of the pragma-dialectic paradigm somehow illustrates a similar 'social turn' in argumentation theory (Eemeren & Grootendorst, 2004), and a few authors believe the 'emotional turn' to also be necessary in this field (e. g. Gilbert, 2004, Plantin, 2011). Nevertheless, little work has proposed to articulate the cognitive, the emotional and the social aspects of reasoning. This may be due to a lack of a theoretical model describing how these three components are integrated in daily collective reasoning. Argumentation studies reconsidered emotions as legitimate research objects a few decades ago, but mostly in a normative perspective (e. g. Hamblin 1970; Walton 1992). Even Gilbert's claim for the study of ordinary interactions, including the emotional mode of argument (2001, 2004), is embedded in the normative framework of elucidating deep emotional motives behind claims to foster successful discussion, or 'coalescent argumentation' (1995). More recently, a descriptive perspective has been applied to the consideration of how emotions work, in real discourses, as key argumentative resources, and not just as marginal fallacious phenomena (Hekmat, Micheli, Rabatel 2013; Micheli 2010; Plantin 2011). Still, there seems to be a persistent reluctance, in the field of argumentation studies, to use the term 'emotions' or 'affects'. A diversity of concepts relate to emotions without mentioning this affective dimension: 'virtues', 'intentionality', 'desires', 'valuation', 'willingness', 'trust', 'motivation', 'self-confidence', 'negative/positive orientation', 'sensitive experience', 'attitudes', etc. Even if they might be very useful for the intended corresponding analyses, such approaches do not address the specificity of their objects as embedded in emotion. This paper aims at contributing to fill this theoretical gap, by proposing a novel, descriptive model of the social and cognitive functions of emotions in collective reasoning, and associated methodological tools to study their linguistic expression.

The conceptual tools detailed here emerge from both prior extensive empirical work about students' argumentative practice (Polo 2014) and an exploration of a multidisciplinary literature that ranges from argumentation studies to research on collaborative learning. The empirical data that led us to design our model consists of videotaped students' interactions debating about drinking water management, in a semi-formal educational setting, in three countries (USA, Mexico, France) and a diversity of socio-economical contexts. Nevertheless, we believe that our model can be applied to other group reasoning settings, such as professional collective work, for instance. Our global approach is characterized, on the methodological side, by a strong attention to language and linguistic phenomena, associated with a major interest in educational concerns. Of course, we are aware that we are not fully recovering the theoretical challenge of describing how collective reasoning works in terms of socio-affective cognition. Indeed, our purpose is not to give a definitive complete model of collective reasoning, but rather to propose a useful theoretical tool to explore a young but promising field of research. In the long run, only by enriching dialogue between disciplines can one hope to fully address this challenge.

This paper is divided into two four main sections. The present introduction is complemented by two subsections which address a) the educational context and the construction of the dataset (1.1) and b) the multidisciplinary theoretical background that inspired the model (1.2). The second section defines two key aspects that serve as a basis for our model: the socio-cognitive aspects of students' argumentation (2.1), the affective dimension of debate framing (2.2), and the relation between the two phenomena (2.3). Throughout section 2, short empirical examples taken from previous work are used to illustrate the main theoretical concepts defined. Finally, section 3 presents the global model that articulates the social and cognitive functions of emotions in collective reasoning. In the conclusion section (4), we further open the discussion on the significance of this model and potential applications.

1.1 Educational context and dataset

1.1.1 Pedagogical setting: semi-formal activity

The previous empirical work that led us to build this model is based on the study of students' discourse along a *YouTalk scientific café*-type activity (Polo 2014). It consists of an extra-curricular two-hour period, held at school, in which students (aged 12-14) are grouped 3-5 to a table. Elder students[1] aged 15-16 lead the activity. The *macro-script* of the café alternates class discussion, working-group discussion, group vote and individual vote, and is based on a multiple choice questionnaire slide show. Some questions, called 'knowledge questions', which consist of stable knowledge for which there is a recognized correct answer, aim at providing basic common information on the topic, while other questions, called 'opinion questions', for which all of the options presented are tenable, are

[1] They were especially trained during 1 day (6 to 8 hours) in order to moderate the *café*.

used to foster socio-scientific debate. The general topic was current and future drinking water resource management.

1.1.2 Complex international corpus of videotaped data

A complex recording setting of the *cafés* allowed the researchers to do multiple-scale analysis and to study what was occurring at both individual, small group, and class levels. The data for each *café* include: a global view of the classroom and moderators' activity, a screen capture of the slide show, and local views of 2 to 4 table-groups. In order to obtain a reasonable volume of commeasurable data, ten cafés were selected for analysis based on criteria of completeness and coherence of the entire event (no technical neither logistical issues). Several aspects of students' argumentation were analyzed: type of collaboration in the small group, use of different argumentative resources (knowledge, norms and emotions), and a comparative study of debate framing along the three countries (Polo 2014).

1.2 Theoretical background: emotions in argumentative interactions

In this section, we provide a short multi-disciplinary literature review on the role of emotions in argumentative interactions, insisting on the aspects that inspired our theoretical model, notably perspectives on emotions coming from argumentation studies (linguistics), and considerations of emotions drawn from the literature on collaborative learning (education research).

1.2.1 Emotions in argumentation studies

In Ancient Rhetorics, the role of emotions, in both the *pathos* and *ethos* dimensions of discourse were included as legitimate components of argumentation. In more recent times, arguing with emotions has often been considered as a potentially fallacious strategy both by the general public and by the critical research tradition in argumentation (e. g. Hamblin 1970, Walton 1992). Many of the '*ad…*' fallacies refer to emotions, one such being a blanket condemnation of any use of emotions: the *ad pasiones* fallacy. This research perspective is based on an ideal model of rational argument, which serves as a reference to assess arguments as more or less valuable.

This paper is based on a theoretical background developed by a markedly different approach which has recently emerged, employing a descriptive perspective on authentic discourse to elucidate how emotions play complex functions in argumentation (Hekmat, Micheli, Rabatel 2013; Micheli 2010; Plantin 2011, Plantin, 2015). Such empirical studies consider emotions as resources that people use to argue, and seek to understand how they are employed in the construction of arguments. This research perspective is especially challenging as emotions can be mobilized in discourse in diverse and subtle ways, often implicitly. A large range of semiotization forms can contribute to the argumentative process. Micheli (2013) distinguishes four types of emotion semiotization in argumentation: 1) "argued emotions", which are thematized and explicitly supported by justifications; 2) "said emotions", explicitly mentioned using emotional lexicon; 3) "shown emotions", inferred from 'downstream' signals of emotion symptom (for instance, a red face standing for anger or shame); and 4) "scaffolded emotions", inferred from 'upstream' signals (for example, a burial is associated to sadness). Plantin's earlier work (2011) suggests diverse indicators for studying emotions in discourse, ranking from deep lexical analysis to emotional inferences based on cultural stereotypes.

Such analysis of the role of emotions in argumentative discourse does not necessarily imply precise labeling: what is found to be more useful is to characterize affects along the axis of valency (whether it is a pleasant or unpleasant) and the axis of intensity (referring to the strength of the affect) (e. g. Plantin 2011; Cahour 2013).

But again, it should be stressed that this research approach relies not on the speakers's *felt* emotions but rather on the emotions they *express* through discourse. Caffi and Janney (1994) oppose the two adjectives *emotional* and *emotive* to distinguish between what is felt (*emotional*) and what is discursively expressed (*emotive*). In practice, the relation between *expressed* and *felt* emotions is problematic and can vary depending on the context. In this descriptive approach of argumentation studies, researchers usually claim that they focus on the *expressed* emotions, basing their findings on discursive material. Still, there is generally no evidence that *expressed* emotions actually differ from *felt* emotions.

Therefore, emotions are not considered as external factors impacting argumentative discourse, but rather as part of this discourse and the associated reasoning. In this descriptive perspective, the analysis aims at understanding how emotions work as resources to argue and how they play a role in the cognitive *schematization* process (Polo, Plantin, Lund, Niccolai 2013). Thus, emotions are not apprehended as independent variables but rather through their relation to knowledge, values and norms in a complex appraisal activity. This approach gives birth to two types of research objects under the term "emotion": emotional feeling attached to an *experiencer* (Plantin 2011, 2015), and emotional tonality attached to *discourse objects* (Grize 1996; 1997, Polo et al. 2013). In the first case, the discourse signifies someone's feeling, corresponding to similar research objects as those studied by Gilbert (2001), for instance, interested in arguers' expressed emotions. In the latter, a more or less positive and intense emotion is associated to a proposition in order to argue for or against it, without necessarily identifying a precise subject as *experiencing* a precise emotion.

Argumentation studies on 'emotions' generally address *expressed* emotions, and do so in diverse ways. Two oppositions structure the field: considering emotions as fallacious strategies or as argumentative resources, and focusing rather on emotional tonality of *discourse objects* or on *experiencers*' emotional feelings.

1.2.2 Emotions in research on collaborative learning

Research on collaborative learning has shown that emotions play a role in the socio-cognitive processes related to learning. Nevertheless, little work has actually focused on this affective component of learning activity, and even less on an integrated perspective of learning process that would apprehend social, emotional and cognitive dimensions. This perspective is currently developing, opening a new and promising field of research (e. g. Baker, Järvelä, Andriessen 2013). These studies show that emotions can play different roles in collaborative learning. On one hand, emotions appear to have a positive role in learning interactions when they are considered as tools to foster socio-cognitive conflict (Roschelle & Teasley 1995). On the other hand, emotions related to learning interactions might threaten group achievement.

In fact, emotions related to argumentative interactions can be beneficial to learning when they correspond to positive 'tensions'. The socio-cognitive dissonance in this case can lead to conceptual or practical change, deepening of the space of debate, or even improving in knowledge (e. g. Andriessen, Pardijs, Baker 2013; Baker, Quignard, Lund, van Amelsvoort 2002; Sins & Karlgren 2013). Sins and Karlgren, summarize the positive role of emotional tensions this way: "*tensions help learners to counter the blindness that is inherent in the way things are normally done and they may uncover a space for alternative actions in a taken-for-granted activity*" (2013: 187). Nevertheless, some conditions are necessary for this type of collaborative learning to occur, such as long-term positive feelings (trust, respect, feeling of social recognition, group identification, etc) (Allwood, Traum, Jokinen 2000) or local specific group emotional moves (relaxation through laughing, off-task activities, etc) (e. g. Albe 2006; Andriessen, Pardijs, Baker 2013; Baker, Andriessen, Lund 2009). Researchers working on these issues generally use discursive clues to assess group reasoning, identifying the type of collective talk developed among the students or co-workers (e. g. Mercer 1996; Asterhan 2013; Michaels, O'Connor, Sohmer, & Resnick 1992).

Some studies also show that emotions related to argumentative interactions can be detrimental to group achievement. Facing a socio-cognitive conflict implies a thematization of disagreement, which is contradictory to ordinary conversation preferences (Traverso 1999), and can be difficult for a group to manage. Empirical data show that students, in small groups, do not always engage in high quality interaction (e. g. Albe 2006). Not all individuals or groups are able to cope with the social and emotional tensions created by the thematization of disagreement, and the cognitive process can be disturbed by these tensions (e. g. Andriessen, Pardijs, Baker 2013). More specifically, negative emotions affect motivation and self or group efficacy feelings (Mullins, Deiglmayr, Spada 2013). Students or co-workers might deal with such tensions using relaxation strategies that do not foster argumentation and learning (Andriessen, Pardijs, Baker 2013). These results about emotional difficulties led educational researchers and practitioners to claim that there is a need to develop studies and tools about emotion awareness[2] and emotion regulation (e. g. Järvenoja & Järvelä 2013).

Research on collaborative learning, when addressing 'emotions', focuses on emotions actually *felt* by the learners, even though mostly relying on discursive markers. In this field, the diversity of studies on emotions is structured through two oppositions: focus on individual emotions and focus on emotional events occurring at the group level, and the distinction between timescales (long-term collaborative climate and group history versus local emotional constructs occurring during a specific task).

	Argumentative studies		Collaborative learning	
Focus	Fallacious strategies vs argumentative resources		Effects on reasoning Individual level & group level	
Method	Discourse analysis		(Mainly) Discourse analysis	
Object	Expressed emotions		Felt emotions	
	people's feeling	objects' tonality	long-term	local constructs

Table 1. Emotions in research on argumentation studies and collaborative learning: key points.

In this paper, we aim at articulating these theoretical backgrounds in a fruitful manner in order to propose a global picture of the role of emotions in collective reasoning. It is important to consider each of these research traditions from the perspective of the other. Firstly, one can thus distinguish at the theoretical level between the diverse emotional objects that may be studied beyond the label of 'emotions', and thus better understand their specific contributions to or impacts on reasoning. The dialogue with collaborative learning research also provides useful empirical data with which one can test and refine key concepts of argumentation studies. Such educational studies analyze authentic practices of non-expert, ordinary argumentators in a group, focusing on understanding how high-quality reasoning occurs. Crossing these two lines of research provides a space for a descriptive but not relativistic approach to emotions and group argumentation.

[2] The *Alpine Rendez-Vous* Workshop on "Tools and Technologies for Emotion Awareness in Computer-Mediated Collaboration and Learning", held in Villard-de-Lans, in Juanuary 2013, is emblematic of this line of research.

2. Specifying social and cognitive functions of emotions in collective reasoning

In this section, we present two sets of conceptual and methodological tools which describe strongly intertwined phenomena, as is later explained in the presentation of the integrated model (section 3). These two dimensions correspond to two types of functions played by emotions in collective reasoning. Firstly, the social function of emotions (2.1) was developed on the basis of analyses of students' argumentation in small groups. As it focuses on the social dimension of reasoning, it is articulated with literature on the type of collaboration in small groups, especially with the typology of cumulative, exploratory and disputational talk[3]. The second dimension relies on the cognitive function of emotions (2.2). Initially analyzed independently from its social function, it corresponds to the use of emotions as cognitive resources to argue, a phenomenon that we mostly studied at the level of whole class debate, and in reference to Grize's concept of schematization (1996; 1997). Even if our argument is mainly theoretical and methodological, we provide a few short examples taken from our data. In all of these examples, the data corresponds to students' discourse during the discussion of the 'opinion questions' of the café.

2.1 Arguing together: group talk and the social function of emotions

In this subsection, we refer to a process that relates the social and the cognitive aspects of reasoning, through the mediation of emotions. We articulate the analysis of group talk, generally associated to more or less cognitive achievement, with a study of specific emotions, which play a role for the quality of group talk. We qualify this approach as addressing the 'social function of emotions' in collective reasoning. The meaning of 'group talk' is defined, both in relation to previous literature and to own prior empirical work (2.1.1), and then the typical emotions associated to group talk (2.1.2) are described, leading finally to a synthetic definition of the social function of emotions (2.1.3).

2.1.1 *Group talk* or linguistic analysis of reasoning as a socio-cognitive process

Studies in education have considered students' *talk* as a research object, based on the idea that it reveals or reflects the quality of reasoning or learning (e.g. Alexander, 2010; Michaels, O'Connor, & Resnick, 2008, Asterhan, 2013). More specifically, in collaborative learning, the focus is on *group talk*, considered as mirroring the nature and efficiency of collaboration in terms of cognitive outcomes. To address the socio-cognitive process of collective reasoning, we find Mercer and Wegerif's typology of *exploratory*, *cumulative* and *disputational talk* very useful (e. g. Mercer 1996; Wegerif & Mercer 1997). *Exploratory talk*, considered of higher educational value, is defined as an efficient and explicit form of collaboration in which 'reasoning is visible in the talk' (Mercer, 1996: 363). On the contrary, *disputational talk* corresponds to little sharing of information and reasoning and 'disagreement and individualized decision making' embodied in 'short exchanges consisting of assertions and counter- assertions' (Mercer, op. cit.: 369). *Exploratory* and *disputational* talk correspond to the two classically opposed poles of a 'heuristic'-'eristic' continuum characterizing argumentative interactions, mentioned by Gilbert (1995: 840) and originating from the founding work Perelman and Olbrechts-Tyteca (1958). Exploratory talk, thanks to the sharing of evidence and explicit reasoning, provides a basis for what Gouran (2004) calls a 'constructive conflict', focused on issues rather than personalities. *Cumulative talk* is also considered of low educational value, even if it is highly collaborative, because it is limited to a discussion in which speakers accumulate ideas uncritically, through 'repetitions, confirmations and elaborations' (Mercer, op. cit.: 369). In terms of the structuration perspective on group argument (Seibold & Meyers, 2007), each type of talk tends to be characterized by the prevalence of some argument strategies among others (even if all the four might be found, to some extent, in each type of talk): extended elaborations, questioning and testing prevail in exploratory talk, while repetitive agreement is very frequent in cumulative talk, for instance. 'Tag-teaming' can be used in a different way, either in *exploratory* or *disputational* contexts, but it would not appear a lot in *cumulative* talk, since no opposed 'teams' emerge.

To conduct a linguistic analysis of *group talk*, we operationalized this typology into a set of 5 indicators, that we define below, with illustrating excerpts taken from a dialogue within Louise, Pamela, Kelly and Sabrina about how the price of water should be determined (opinion question 3)[4].

1) Are assertions and refutations are justified? We then search for segments of discourse such as the part of the following utterance that appears in bold[5]:

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[3] This typology was developed by Mercer and his colleagues, see the following references: Fernández, Wegerif, Mercer, Rojas-Drummond 2002; Mercer 1996; Mercer & Littleton 2007; Mercer, Neil, Wegerif, Dawes 1999; Mercer and Sams 2006; Wegerif, Littleton, Dawes, Mercer, Rowe 2004; Wegerif & Mercer 1997.

[4] Opinion question 3 is as follows: "*How should the price of water be determined? a) drinking water should be free; b) drinking water should be sold at a price that covers the costs of its production; c) drinking water should be sold at a price that depends on its quality; d) drinking water should be sold at a price that depends on family income; e) drinking water should be sold at a price that depends on how it is used; f) water should be free up to a reasonable amount, beyond which it should be sold at a high price*".

[5] The conventions used for all the transcripts are detailed in appendix 1.

LOU		er: i think it should be priced by its quality **because if [you'd have better quality it's just more work to like produce it**

2) Do the participants elaborate on the argumentative content of previous turns? Such topical alignment are sometimes embedded in gestural or verbal repetitions, as in the following example, with Kelly's rephrasing of 'work to produce' into 'production', adding a referential gesture, which Louise repeats at turn 4:

1.	LOU	er: i think it should be priced by its quality because if [you'd have better quality it's just more **work to like produce it**
2.	KEL	[((nodding head in the affirmative, looking at Louise))
3.	KEL	em: there's more [**production <((turning hands)) for it to>**
4.	LOU	[((turning hands))

3) Do they critically evaluate each other's arguments? Studying this indicator usually implies large sets of dialogues. In the limited space of this paper, we here only reproduce two opposed turns of the conversation:

8.	SAB	and what about (.) family income/ you need water\
(…)		
12.	LOU	they could like they could overu:se like they could (.) not pay as much and <((turning hands)) get more water>

After a collective elaboration of Sabrina's proposition, at turn 8, to have the price of water depend on family income (turns 9-11), Louise, at turn 12, expresses a concern for a potential undesirable effect of this proposition. With this *ad incommodum* argument (Plantin, in press: 30), she takes a critical stance on Sabrina's claim.

4) Do they take everybody into account when making the collective final decision? In our data, the students have to come to a common group answer on each opinion question, which is then displayed in front of the whole class. Still, we believe that, even in other settings, this indicator is useful as long as the discussion aims at making an explicit choice. It is essential to understand that concern to have all the group members' consent for the decision does not necessarily imply that the group reaches a consensus. For instance, in the present case, the students solve the problem by the required selection of one option while providing for the expression in the class debate of another option that some group members supported:

41.	PAM	just put C and i'll explain like why we think D too\
42.	KEL	yeah:\
43.	SAB	<((putting card C)) well i'm putting C\>
44.	LOU	C\

Usually, when indicator 4 is positive, each member of the group explicitly shows engagement in the decision made, either verbally or gesturally.

5) Does a particular student's talk during the class-scale debate integrate the rest of the group's supporting or opposing argumentation? Or does it rather only voice the speaker's own initial ideas? The pedagogical situation studied is emblematic to track this type of elaboration. Here, Pamela actually rephrases at the class level the different viewpoints developed earlier in the group-scale debate:

PAM	oh yeah C and D because em: like we chose C because em: like (0.9) <((opening hands, turned to the sky)) oh i can't really explain> <((hands back to the table)) but like (0.5) however like like however like much time it's putting like (0.3) prod- like producing the water/ should be like (1.0) sold at a higher price like if it's like more better quality it should be sold at a higher price but if it's just (0.5) <((skeptical face)) regular water [i guess> like it should just be (0.7) like affordable\ and then we (0.2) thought D too because em: we thought that like less fortunate families shouldn't be like (0.5) punished not really punished but shouldn't like (.) have like a: <((moving hands)) lack of water> because (.) of like their jobs or whatever their income

More generally, this indicator can be applied to any context where exploratory talk might occur. It corresponds to a deepening of reasoning embedded in the development of complex dialogical arguments that takes into account counter-arguments. Independently of who voiced the initial idea or its critical assessment during the group discussion, the final argument made by an individual is strengthened by previous *group talk*. This can be described in terms of rebuttals in reference to Toulmin's pattern of an argument (1958).

These indicators made it possible to identify clear cases of *exploratory talk* in each national sub-corpus (Polo 2014: 123-155), and to specify the characteristics of *cumulative* and *disputational* sequences. *Disputational talk* is mostly characterized by a rather negative indicator 1 (repetitions instead of justifications), intermediate indicator 2, strong but unconstructive use of critical sense (indicator 3) and negative indicators 4 and 5. *Cumulative talk*, on the other hand, is characterized by very low critical sense (indicator 3), as if the discursive and interactive exploration was restricted to the uncontroversial side of the issue at stake.

Moreover, confrontation to authentic data led us to refine this typology. Some group debates of students discourse (3-minute-long on average) could not be fully characterized globally as *exploratory*, *cumulative* or *disputational*. We therefore adapted these categories to a thinner analytical grain, and multiplied the analytical scales, distinguishing the global *phasis* (the whole dialogue) from the topical *sequence* (the part of the dialogue corresponding to the same argumentative question), and local *sub-sequences* serving specific purposes (expository,

closing, etc)[6].

2.1.2 Recognition-oriented emotions associated to *group talk*

In our data, it appeared that sometimes, the same group of students could engage in different type of *group talk* along the *café*, including global exploratory phases. Therefore, their cognitive ability to engage in *exploratory talk* cannot be questioned, and the matter of understanding why they tend to develop a given type of talk is rather to be elucidated by studying the social side of the process. Our interpretation is that, in addition to the necessary cognitive ability, a group would engage in *exploratory* talk only if it corresponds to the perceived *socially relevant* form of talk. The group members align their expectations about the relevant type of talk on the basis of specific emotions expressed in the interaction. These specific emotions are associated to how social recognition is ensured in the present dialogue. Each student displays a *self-identity footing* regarding which type of group talk she/he is ready to engage in, expressing recognition-oriented emotions, and adjusting to others' expression of such emotions.

Such interpretation is based on previous literature, and strongly related to linguistic politeness. To engage in argumentation with their peers, the students need to switch from the ordinary *position-driven* interaction to a different, *issue-driven* one (Keefer, Zeitz, Resnick 2000). This shift implies a change in *politeness* code and the ways in which they seek *face preservation*. The thematization of disagreement, which is in the core of argumentative practice, can have different social meanings, associated to several types of *politeness* rules and ways to ensure *face preservation*. Ordinarily, a structuring element of interactions is *facework*, the activity of seeking to preserve one's own and others' *face*, or positive social value (Goffman 1974; Brown & Levinson 1988). This concern for *face* leads the participants to use a complex *politeness* system that constrains the development of interaction. One of these empirically observed rules is the preference for agreement over disagreement: disagreeing is marked as an interactional *impolite* action whereas agreeing is commonplace (Pomerantz, 1984). Therefore, people would only thematize disagreement in specific social contexts, or if the issue is important enough to them (Traverso 1999). This has to do with the interactional goals. While ordinary conversation is oriented toward the creation and strengthening of interpersonal relations (focus on the *subjects* engaged in the interaction), some special interactions, as didactical interactions, are rather oriented towards the *objects* of the interaction (Jacques 1988).

In disputes in general and, more specifically, in argumentation, face preservation obeys a particular *politeness* system, which follows different rules than the ordinary system (Kotthoff, 1993, Plantin in press: 368-369). *Face* preservation interactional work is then different from usual *facework*. The argumentative *script* relies on each participant to disagree and take turns in adopting a *proponent* or an *opponent footing* (Plantin in press: 26-27). Therefore, disagreement becomes usual and is not especially 'marked'.

When working in a small group, it might be difficult for the students to know which type of *politeness* system to use. In real life, there might be alternation between ordinary *position-driven* interactions and educational or professional *issue-driven* interactions among a given group of people, over a short period of time. The students might feel uncertainty about the ongoing *politeness* rules, and/or difficulty in getting aligned on and adapting to a similar face-preservation system. In this context, the expression of recognition-oriented emotions works as clues for the group members to engage in a common type of *group talk*. When a participant expresses emotions about whether her/his *face* is well preserved or endangered by a given interactional or argumentative move, others can infer his/her *self-identity footing* toward *group talk* and adjust their own footing consequently. For instance, a student may adopt a *competitive footing* when feeling offended by a criticism and moreover stick to a position rather than accept a joint critical evaluation of the positon (Muntigl & Turnbull 1998; Baker & Andriessen 2009). This individual attitude fosters *disputational talk* at the group level.

This relation between *self-identity footing* (*competitive*, *consensual* or *constructively critical*) and engagement in specific types of talk and collaboration (*disputational talk*, *cumulative talk*, *exploratory talk*) is summarized in figure 1.

[6] 'Phase' here corresponds to 'planned tasks sequentially organized that take part to the pedagogical activity' (Bouchard & Rollet 2003). In this context, a phasis consists of a group discussion about a given opinion question (lasting from 3 to 5 minutes).

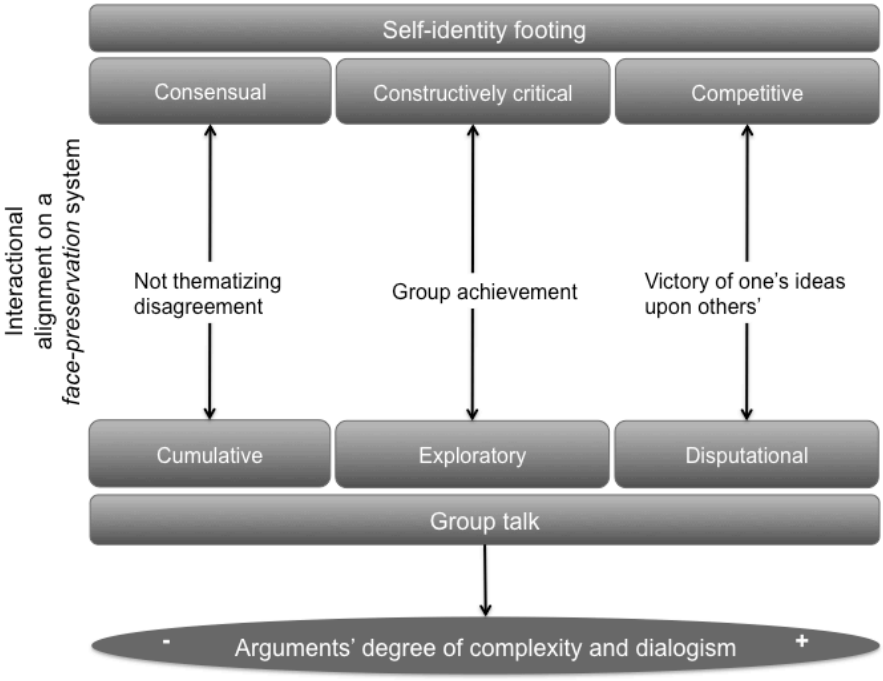

Fig. 1 Group talk, individual *self-identity footing* and *face* preservation system: a synthesis.

Exploratory talk is precisely characterized by the fact that social recognition does not rely on agreement to individual opinions, but rather on cognitive group achievement through the discussion process (Wegerif & Mercer 1997). In these respects, *exploratory talk* is similar to *co-constructive critical argumentation* (Asterhan 2013). Such collaboration requires each student to 1) adopt a *constructively critical footing*, focusing on deepening the understanding of the issue, and 2) seek *face* preservation in the results of the collective work. For instance, when students adopt such *constructively critical footing*, they do not fear to express doubt, as in the following turns from Sabrina, Louise, Kelly and Pamela's exploratory talk about opinion question 3 (cf. footnote 4):

1.	LOU	er: i think it should be priced (…)
7.	KEL	em: (…)
(3.8)		
19.	KEL	er:
20.	LOU	er: i would say C but what are you guys saying/ (…)
30.	SAB	yeah\ i think it's either C or D\ (…)
33.	SAB	maybe C AND D\ 'cause like (…)
39.	KEL	i don't know:\ (0.8)

Another interesting aspect is that, in exploratory talk, when all the students are displaying a constructively critical footing, there's no shame at changing one's mind. Here, at turn 20, Louise explicitly asks others' opinion after strongly mitigating her attachment to her own choice, a way to show that she is ready to be influenced by their ideas, without any risk for her face.

Case studies of typical *cumulative talk* and *disputational talk* debates (*consensual dialogue* and *adversarial argumentation* in Asterhan's terms) show that failure to engage in *exploratory talk* is related to the lack of adoption of a *constructively critical footing*, or to the fact of not searching *face* preservation in the results of the collective work. In *cumulative talk*, the discussion of the issue is restricted to a non-controversial process similar to daily conversation. The participants individually stand on a *consensual footing*, seeking *face* preservation through agreement rather then by elaborating complex discussion objects. The same group's dialogue about the potential sources of drinking water for the future (opinion question 1)[7] is emblematic of *cumulative talk*:

2.	SAB	cause i feel like people waste a lot of water
3.	KEL	yeah [xxx
4.	SAB	[like washing their dishes like before they put them in the dishwasher like brushing

[7] Opinion question 1 is the following: "*In your opinion, which potential source of drinking water is the most promising for the future? a) the discovery of new fresh water deposits; b) water that we don't use today (that which, is economized); c) desalination of seawater; d) climate change leading to more rain; e) new techniques for the depollution of water; f) none of these are promising: water is going to be in short supply and will become THE conflict of the 21st century*".

		your teeth, [showering
5.	KEL	[or showers
6.	PAM	showers yes (…)
17.	KEL	or like washing your car
18.	PAM	yea[h:
19.	LOU	[oh yeah
20.	KEL	and then all the chemicals in it go in the grass (.) which is not good
21.	LOU	((laughs))

Here *face-preservation* is ensured by disagreement avoidance, and social recognition is associated to positive evaluation ('yes', 'yeah') and elaboration on whatever a group member says. Even asking for justification seems prohibited, and the students only accumulate a list of practices without rendering explicit how they are related to the topic. Even when Kelly refers to the chemical pollution of grass, which is not the relevant aspect of car washing for the topic, no one critically assesses her proposal. Instead, Louise laughs, perhaps expressing complicity.

In *disputational talk*, there is strong disagreement, but little collective reasoning. The students display a *competitive footing*: the aim is not to reach the best collective result, but to have one's own argument triumph. *Face* is strongly attached to the individual's opinions, and criticisms are seen as offenses and lead to counter-attacks. This is consistent with Gilbert's claim that emotional arguments are more likely to occur as one is more attached to the viewpoint she or he is defending (1995). In the following excerpt, Asa, Isabelle, Samira and Klara's discussion about the efforts they would be ready to make to economize water (opinion question 2)[7] is emblematic of *disputational talk*. Several times, they express a strong attachment to their own initial idea and a reluctance to have it questioned, often reacting strongly to other options as if offended:

2	ASA	°c'est la A\ nan\° (°it's A\ isn't it\°)
3	KLA	°**nan jamais moi**\° (°no I would never ever\°) (…)
12	KLA	°**mais moi** j'fais pas l'C hein\° (°but I don't do the C ok\°) (…)
15	KLA	**moi** c'est F hein\ (me it's F ok\)
16	SAM	**merci** (thanks\)
17	ISA	**moi** j'mets la E hein\ (I put E ok\)
18	KLA	oh **non moi** j'fais F\ (oh no I do F\) (…)
33	KLA	**nan mais** ça <((geste de la main désignant SAM et KLA)) c'est **notre avis à nous** deux\> <((geste de la main vers les 2 autres)) vous euh mettez c'que vous voulez\> (no but that <((hand pointing at SAM and KLA)) it is our opinion of the two of us\> <((hand pointing at the two others)) you em put what you want\> (…)
37	ISA	**mais**: elles: sont **bêtes** hein\= (but: they: are stupid\=)
38	ASA	=**nan mais** elles sont <((levant les mains pour ponctuer)) **débiles** à un point mais pas possible\> (=no but they are <((hands preparing a beat)) so stupid it's not believable\>
39	KLA	**<((main vers elle comme pour dire 'stop')) ça va asa hein\>** (<((palm to her as a 'stop' emblem)) it's enough asa ok\>) (…)
43	SAM	**nous on a notre avis** après vous avez **l'sien** (we we do have our opinion you have hers\) (…)
78	SAM	si:\ [prendre moins d'douches et d'bains\ (ye:s\ [take less showers and baths\)
79	PRO	((part)) ((leaves))
80	ASA	[ah: **tu m'affiches pas avec ça** hein\ ([ah: you don't put shame on me with that ok\)
81	ISA	<((grimace)) ah: **t'es sérieuse** là/> (<((face of disgust)) ah: are you serious/>) (…)
116	KLA	<((à une autre table)) **moi** c'est **mon état d'esprit\>** (<((to another table)) me it's my way of thinking\>) (…)
155	SAM	ben oui je sais **nan mais** j'suis [toujours **pas d'accord** c'est tout\ (yeah i know no but i still [don't agree that's all\)
156	KLA	[F\ (.) **nous** on n'est **pas d'accord/** ([F\ (.) we don't agree/) (…)
161	SAM	<((riant)) **nous** on n'est **pas d'accord** klara\> on va **<((pose le poing sur la table)) débattre\>** (<((laughing)) we do not agree klara\> we gonna <((hand beat on the table)) debate\>) (…)

These excerpts are characterized by the use of a lot of personal pronouns and possessives, especially at the first person ('moi'; 'nous'; 'notre'; 'mon'), showing a strong emphasis on the personal attachment of the propositions. Klara, who expresses, from turn 15, a reluctance to consider other ideas, and even more to question her initial choice, explicitly mentions, at turn 116, how her identity is attached to her opinion: 'c'est mon état d'esprit'. The short exchange of turns 37-39 marks a tendency to turn into open conflict, with insults, and Klara's verbal and

[7] The English version of opinion question 2 is "*Which of these things would you be the most willing to do? a) take fewer baths and showers; b) use my phone and computer for a longer time before getting a new one; c) eat less meat; d) use dry toilets; e) all of that, and even more; f) I'm not ready to make any of those efforts*".

gestural reaction to these offenses. All along this phase of discussion, disagreement is made explicit and repeated, with many opposition markers ('nan'; 'mais'; 'pas d'accord'). Samira, after being prompted by the teacher (PRO), suggests a practice to economize water, at turn 78, but, as soon as the teacher leaves, Asa and Isa's counter-arguments are fully emotional. Asa claims she would be ashamed if Klara were to bring this idea up during the class-level debate (turn 80), which stops any potential constructive discussion at the group level: there is no attempt to engage with each other's ideas. Isabelle even questions Samira's sincerity, thus discrediting her idea without even really considering it.

Considering the specificities of argumentative interactions regarding *face preservation* is key to addressing the social side of emotions in group reasoning. Attitude toward *self-identity* has a direct impact on the type of emotions students might display during the group debate. Engaging in high-quality group interaction requires the students to adopt a *politeness system* in which there is no shame in expressing ill-structured ideas or changing one's mind, nor aggressiveness in criticizing others' views, nor sadness at not convincing everybody that one's initial idea was the best. Students rather experience happiness at shifting from individual initial arguments to collective stronger ones, which corresponds to intrinsic motivation (Ryan & Deci 2000).

2.1.3 Social function of emotions: a definition

The social function of emotions refers to this complex system of emotions related to social recognition, in a given group and context. Here, what counts are participants' *felt* emotions, as they appear in discourse. They are strongly related to the display of a specific individual *self-identity footing*, which can be either *consensual*, *constructively critical*, or *competitive*. The adoption of a *self-identity footing* is related to the type of *politeness system* that is perceived as contextually relevant by the student, and is an inherently social practice involving phenomena of (dis-)alignment and (dis-)affiliation among the group members. These emotions are essential to engage, at the group level, in high-quality argumentation and collaborative reasoning. Alignment on a *constructively critical individual footing*, for instance, is necessary for the group to develop *exploratory* talk. In terms of cognitive outcomes, students are thus better able to build more complex and dialogic arguments (Polo 2014: 121-155). The 'group' at stake here is the actual group of people sitting round the same table. It is worth noting that *politeness* rules and *facework* dynamics 'filter' the way any *felt* emotion is signified in this group, as symbolized in figure 2. The relation is bidirectional. On the one hand, expressed emotions play a role in the interactional alignment on a *face-preservation* system, in relation to individual *self-identity footing*, and the type of *group talk*. And, on the second hand, the type of *group talk* and established *face-preservation* system make it more or less appropriate to express a given emotion. Doubt, for instance, has a great relevancy in *exploratory* talk, and can be expressed without any risk for *face*, which in not the case in *disputational* talk, where doubt is associated to weakness and detrimental to face.

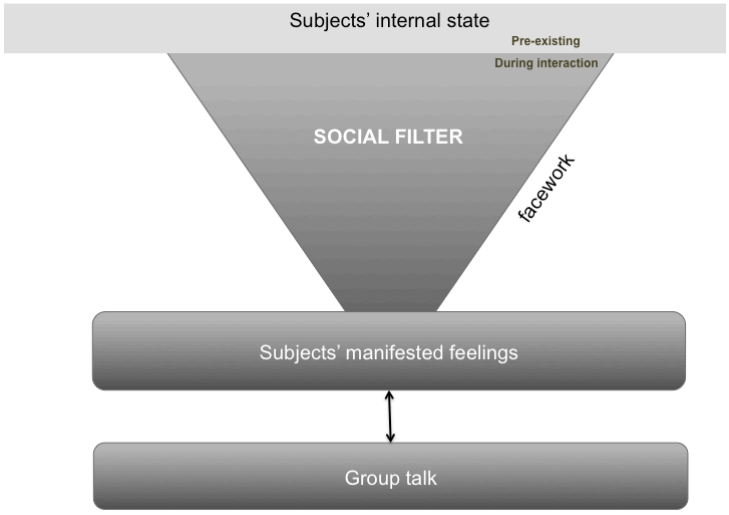

Fig. 2 'Social filter' realized through facework, and the relation between signified feelings and group talk.

2.2 Arguing together: *schematization* and the cognitive role of emotions

The second, cognitive function of the role of emotions in collective reasoning was initially analyzed independently from its social function, on data based on class-level debates. It aims at studying the use of emotions to build arguments in defense of a claim, bringing focus to the role of emotions as cognitive resources in reasoning. This analysis is based on Grize's concept of *schematization* (1996; 1997), studied on its emotional aspect.

2.2.1 *Discourse objects'* emotional tonalities: conceptual and methodological tools

Here, the emotions considered are not subjects' feelings, but emotional tonalities attributed to the *discourse objects* of the debate. In their discourse, the students build images of the issue and the alternative options of answer, through a *schematization* of *discourse objects* (Grize 1996; 1997) oriented towards a preferred option. A large part of this process is affective framing, attributing an emotional tonality to the argumentative question and each of the options[8]. For instance, the same emotional and argumentative implications are not drawn when considering lower-class people as lazy and unaware of the environmental crisis or when depicting them as innocent victims during a discussion about how the price of water should be determined. In this process of emotional schematization, the participants can use a variety of more or less explicit semiotic modes (Micheli 2010), and generally ground their discourse on cultural preconceptions about what should be more or less positively or negatively valued (Plantin 2011). The resulting emotional tonalities are characterized in terms of intensity and valency.

These tonalities were analyzed in 3 final class-level debates from each of the countries in our corpus (Mexico, the US, France), on the basis of tools defined by Plantin (2011)[9]. We consider the valency of emotions along four dimensions: 1) the life-death continuum, 2) the positive-negative consequences, 3) the positive-negative analogies, and 4) the conformity to established principles. This fourth dimension consists for instance of implicitly attributing a positive emotional tonality to an option is by representing it as conforming to strongly established general laws, norms, or values. In terms of emotional valency, the following utterances are totally opposed, the first one rather tending on the death pole of the continuum (1), arguing about the negative consequences (2), while the second one is oriented toward the life pole of the continuum (1), supporting an option of answer by focusing on its anticipated positive consequences (2):

3	ABI	that means no water\
36	JIM	then you gonna probably gonna be able to get it easier\

The analogies used (3) are also likely to confer a more or less positive emotional tonality to the issue. For example, the geographical metaphor tends to frame the access to water as a neutral fact, like the presence of mountain ranges or forests:

36	JIM	a place that's more populated with water

On the contrary, the metaphor of the robbery implies a negative tonality:

KEV	the water has just been taken and so is out to bigger countries

Last but not least, a large part of the discursive construction of emotions along the valency axis relies on the reference to shared principles (4). Consider the following turn:

30	ROS	if we develop a system in which we can continue to save water instead of just (.) trying once in saving a quarter free (renove it) to really make it in the future so:

Here, Rose is arguing in favor of option C (access to water in the future will depend on the water which is economized now), and against the rival option D (access to water in the future will depend on where on the globe a person is born). She refers to two principles. First, option C is presented as conforming to the factual law that 'if you economize something, more of it will be available in the future'. Second, on the axiological side, option C is framed as conforming to the fundamental norm of sustainability, that 'one must ensure that the next generations will have the resources to meet their needs'. Moreover, a student arguing in defense of option D and against C has just claimed that economizing (option C) cannot be a long-term solution due to the fact that someone would end up using the economized water anyway. In this utterance, Rose also counter-argues this objection by using a third principle, the procedural norm of having to search for a long-term solution, and reversing its initial argumentative orientation.

In terms of intensity, key factors are 1) the distance to the issue (in space, time, and concerned people), 2) the degree of control and 3) the causality/agency dimensions (you don't blame fatality, but you can feel indignation watching an unfair deliberated decision). Consider the two following utterances:

[8] This approach is similar to the Anglo-Saxon frame analysis. As a discursive construct, 'frames', as schematizations, 'induce us to filter our perceptions of the world in particular ways, essentially making some aspects of our multidimensional reality more noticeable than other aspects' (Kuypers, 2009, p.181). As a process, 'framing', as well as 'schematization', 'encourages the facts of a given situation to be interpreted by others in a particular manner' (Kuypers, 2006: 8). Nevertheless, frame analysis is related to the critical tradition in discourse analysis, which does not fit with our radically descriptive epistemological approach. Moreover, the schematization process applies at a smaller scale, the one of discourse objects. We sometimes use the term 'emotional framing' to refer to the global emotional position resulting from the sum of the emotional tonalities conferred to each considered discourse object, for a specific 'team' defending the consistent argumentative claim.

[9] The following excerpts are taken from a debate among American students about the final, main question of the *café*: "*In your opinion, in the future, whether a person has access to drinking water will depend on…? a) on how rich the person is; b) on how physically able the person is to live with lower water quality; c) on efforts made, starting now, to save water by using less and to protect water resources; d) on where on the globe the person is born; e) on nature's capacity to adapt to our needs for water; f) on scientific advances*".

19	ROS	what we do now will break the em you know who has access to water drinking water in the future\ (.) because if we abuse you know like using water in a way we are now it would it should xxx probably\ so we could now if we start to use less xx and it would xx more: available drinking water\ for (those) in the future
42	STA	<((shrugging)) to adapt to the water> we need/

In terms of distance to the issue (1), Rose's contribution to the debate is of lower emotional intensity: the concerned people are described using the third person ('who', 'those'), and in a distant time ('in the future'). On the contrary, Stacey uses the present, and the first person ('we need'), framing the issue as much more intense, as less distant to herself and the other students, and, more generally, as concerning the whole human kind. Turn 19 also provides information about the degree of control (2) and the causality/agency (3) associated to the issue. Rose, who defends option C (access to water in the future will depend on the water which is economized now), *schematizes* the access to water as both caused by and likely to evolve because of human action, using the general first person 'we'. She prefaces the debate by pointing our global responsibility for the issue (3) but, simultaneously, she lowers the emotional intensity of the issue on the control dimension (2) by claiming that the situation is controlable. Jim's later contribution contrasts a lot with Roses along axes 2 and 3 of emotional intensity:

36	JIM	if you live in a place that's more populated with water than other places then you gonna probably gonna be able to get it easier\

Here, access to water is only presented as resulting from random natural distribution, independent from human action. The lack of control on the situation (3) tends to increase the emotional intensity associated to the issue, but the fact that no agent is claimed responsible for it (2) cools the debate down. Such emotional framing is constitutive, as a cognitive process, of the argumentative discourse in defense of option D (access to water in the future will depend on where on the globe a person is born).

Another important theoretical tool is the distinction, coming from psychology, and introduced in linguistics by Plantin (2011), between *thymic* and *phasic* emotions: the first one corresponds to the initial 'state of composure', a basic frame in which *phasic* emotional variations appears. Methodologically, for our concerns, this opposition was adapted and helps us distinguish between the generally accepted tonality of the debate and the variations corresponding to the use of emotional framing strategies to defend the rival options.

These *emotioning parameters* were analyzed on the basis of discursive markers (use of pronouns, emotion lexicon, etc) and on an analysis of implicitness (causal reasoning and use of inferences) for the final class debate on the main question of the *café* (Polo 2014: 307-358). These studies show that students defending the same *argumentative conclusion* (here one of the options of answer) adopt similar *emotional positions* toward the issue (Polo, et al. 2013).

2.2.2 Cognitive use of emotions and its ad hoc socialization

These three case studies led to two key conclusions. First, students often use emotions as argumentative resources in defense of an option indicating the 'right choice', in relation with widely shared cultural beliefs and knowledge. In authentic students' argumentation, there is no clear frontier separating emotions from 'reason'. Second, students sharing the same view are not only engaged in an alignment process but rather in a co-constructive one: independently of who is speaking, all the contributions to the debate defending a certain option show characteristic, coherent *phasic* emotional variations. For instance, students defending the idea that future access to drinking water will depend on efforts made to economize water present the problem as concerning them all, creating a very short emotional distance from the issue. On the other side, students defending the idea that access to drinking water will depend on how rich a person is, establish a greater distance from the issue, which is thus represented as concerning only the poor, or people different from them.

An interesting feature of this class debate is that, even if it comes after the group debate, the students do not only defend their group answer, but are also free to voice their own, personal view. Sometimes, a student finally argues in the class debate in favor of a different option than the one chosen by his table group. Occasionally, a student even publicly changes his/her mind and defends a different option at the end of the class debate from that which he or she defended initially. During this final debate, some 'sides' emerge, in which students *de facto* work together to create arguments in favor of a specific option of answer. Doing so, they also produce emotional *phasic* variations consistent with their argumentative orientation. If those students are not seated around the same table, they are somehow specifically related to each other by a common cognitive and emotional appraisal of the objects under discussion, creating *ad hoc* alliances, through (but not exclusively) 'tag-teaming' (Seibold & Meyers, 2007). Figure 3 summarizes this emotional schematization process and associated alignments.

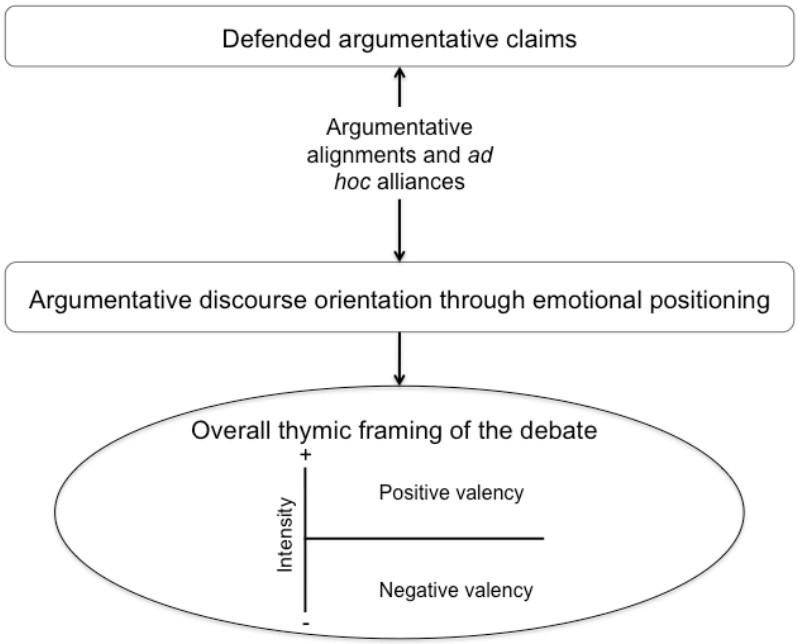

Fig. 3 Defending an argumentative claim as emotional positioning: dynamic visualization and thymic outcome.

2.2.3 The cognitive function of emotions: a definition

What we call the cognitive function of emotions refers to the key role of emotional framing in the global process of *schematization* (Grize 1996; 1997). Attaching emotional tonalities to *discourse objects* is a key dimension of discourse in general, and argumentative discourse in particular. What Grize calls a *schematization* corresponds to an argumentatively orientated representation of a thing in discourse. The term "orientation" refers to the work of Ancombre and Ducrot on argumentative value of language itself (Ancombre & Ducrot 1997), which is here expanded to larger discursive units. Any *emotional tonality* associated to a *discourse object*, more or less positive, negative, strong, slight, or even neutral, results from an active discursive work conveying a specific, argumentatively-orientated vision. These emotional tonalities are founded on shared knowledge, values and norms, and play a great role in the construction of an appraisal of corresponding argumentative propositions (Polo et al. 2013). In this perspective, emotions are totally integrated into the cognitive processes of building and defending an opinion about an issue (here, the students are defending option A, B, C, D, E or F, on the basis of the multiple-choice pedagogical material which serves as a basis for discussion).

On the basis of intellectual affinity, all the contributions to the debate of an *ad hoc* group of students defending the same argumentative conclusion tend to similar *phasic* variations, specifying an associated common *emotional positioning*. The sum of the discursive work of the rival *ad hoc* groups as they argue impact the general global emotional framing of the debate, or its *thymic* tonality, at the class level. In sum, there is a bidirectional relation between the emotional tonality conferred to discourse object through schematization and the emotional positioning that orients discourse toward the defended argumentative claim. Figure 4 roughly synthesizes this cognitive function of emotions in an argumentative interaction.

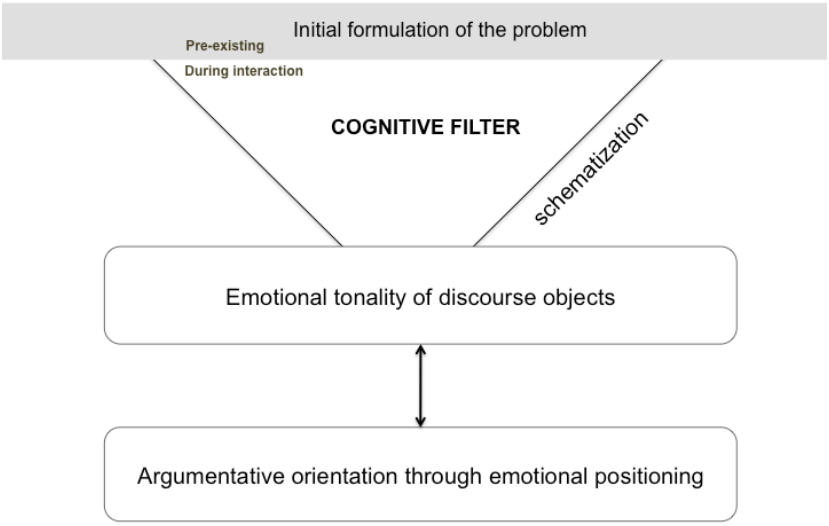

Fig. 4 'Cognitive filter' through *schematization*, and argumentative orientation through conferring emotional tonality to *discourse objects*.

3. A model of the role of emotions in collective reasoning

One one hand, studying the relation between the cognitive and the social aspects of group argumentation led us to emphasize the role of specific emotions related to social recognition (2.1). On the other hand, analyzing the role of emotional framing in the cognitive process of *schematization* in argumentative interactions revealed that *ad hoc* alliances resulting of collective emotional positioning were structuring elements of the debate (2.2). These interconnections deserve to be addressed on a theoretical level, in order to better understand how the social, affective and cognitive aspects of collective reasoning work in authentic argumentative discourse. In this section, we integrate these social and cognitive functions of emotions into a global model of how emotions shape collective reasoning, represented in figure 5.

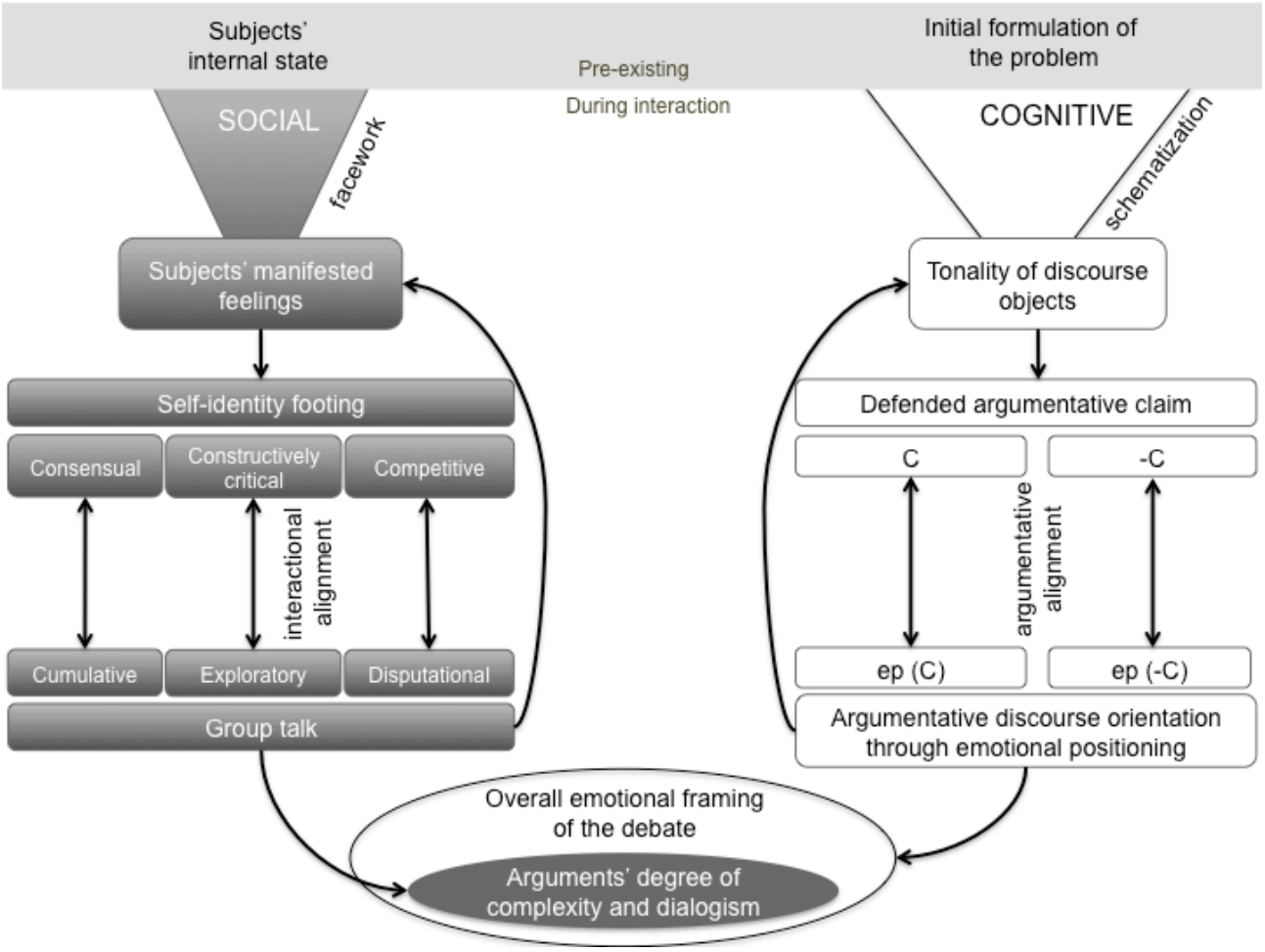

Fig. 5 The functions of emotional entities in the sociocognitive activity of collective reasoning.

In this model of the role of group emotions in the discursive, socio-cognitive process of reasoning together, their social (dark boxes) and cognitive (white boxes) functions are distinguished and interconnected. Before getting to what happens during the argumentative interaction, it is essential to remember that an interaction never starts from scratch. Each student comes to the table with his or her own preexisting internal emotional state, which includes *a priori* feelings about the *objects* to be discussed, and the *subjects* to be involved in the task. For instance, each individual is more or less tired, has unique past experiences of group work and conversational history with other members of the group, a high or weak self-efficacy image corresponding to the topic, etc. Generally, when you do interaction analysis, you have little to no access to these preexisting feelings, which are rarely thematized during the activity.

On the cognitive side, the initial formulation of the problem or question to be debated by the group also constitutes an *a priori* framing of the activity, which is not emotionally neutral. Collecting the pedagogical material gives great insight into this initial emotional *schematization* of the *objects* to be discussed. Nevertheless, this formulation might mean different things to the participants, depending on the cultural and linguistic references it activates for each of them. In this aspect, it is clearly related to a larger global set of references, or 'interdiscourse'[10], including school, family, and media discourse.

When the students (or participants) engage in the interaction, some aspects of these pre-existing entities are selected and filtered, adopting a discursive form to be shared among the participants. Two processes, a cognitive one and a social one, give birth to two distinct emotional discursive entities, the participants' signified emotions and emotional tonalities conferred to *discourse objects*. On the social side, the politeness system and, more specifically, the concern to preserve one's and others' *face* (*facework)* constrains which emotions the *subjects* manifest, and how they thematize their own and others' *feelings*. On the cognitive side, participants define and categorize the initial

[10] The concept of 'interdiscourse' has been used and defined in different ways and is characterized by a complex historiography (Paveau, 2010), that we unfortunately have no space to detail here. This classical notion of the French discourse analysis finds its roots in from Pêcheux (1969). Amossy briefly introduces this concept as a part of the basic toolbox for the analysis of argumentation (2006: 94-99). Following her approach, we here only mention 'interdiscourse' as far as it corresponds to 'a necessity, to identify and assess the function of doxic elements, to perceive the utterance in relation to the other discourses from which it is elaborated' (Idem: 98).

problem in the course of discussion, insisting on some aspects more than others. This *schematization* process is partly emotional: the *objects*, as they emerge in discourse, are given an *emotional tonality*. These two emotional entities are not necessarily fixed and stable at any given point of the interaction. On the contrary, they are unceasingly recreated during the debate, in real-time, with each participant monitoring his own and others' *manifested feelings*, and specifying the vision of the problem he or she is acquiring through an appropriate *emotional schematization*.
We here first introduce this processes at the individual level (3.1), then describe how it is articulated at the group level (3.2), and finally presents the outcomes of the role played by emotions in collective reasoning (3.3).

3.1 Emotions in collective reasoning: focus on the individual level

At the individual level, the way participants manifest and interpret *feelings* in the interaction is essential in their choice of adopting a more or less collaborative *self-identity footing*. They can either be *consensual*, and avoid thematizing disagreement to preserve their own and others' *faces*; or *constructively critical*, seeking face preservation through group achievement; or *competitive* and try to have their own ideas defeat those expressed by others, even if it is detrimental to group achievement. For instance, in the case of a competitive footing, a criticism is understood as a threat to the proponent's *face*, who would manifest offense and react with a retaliatory counter-attack or actions aimed at the opponent. Even if this positioning is individual, it is a deeply social phenomenon, since it is structured by how one builds and defends his *face*, which can be defined as his positive social value, with associated emotions.
On the cognitive side, the *emotional tonality* discursively conferred to *objects* under discussion orients participants toward the choice of an argumentative claim. At the individual level, one decides to defend an alternative, which is competing, within the debate, with one or several other options (here, the students might choose option A, B, C, D, E or F). To simplify the model, we only represented two options in figure 5, claim C and the opposing claim –C, while in reality clearly more than two alternatives can be under discussion.

3.2 Emotions in collective reasoning: collective alignment processes and group phenomena

Throughout the interaction, the participants adjust both their social and cognitive individual positions, through processes of (dis)alignment resulting in specific collective configurations. Through *interactional alignment*, the participants get engaged in a specific type of group talk. When each member of the table-group is aligned on a consensual footing, the group talk is cumulative; when they are aligned on a constructively critical footing, the group talk is exploratory; and when they are aligned on a competitive footing, the group talk is disputational. In specific transitional sub-sequences of the interaction, the participants may be *disaligned* on the social side, and no clear specific type of talk can be identified at the group level.
Through *argumentative alignment*, those defending the same *argumentative claim* tend to develop a similar *emotional position* toward the problem and all the alternatives under discussion. Someone convinced of option C, for instance, would emotionally *schematize* not only option C, but also rival options as well as the problem definition itself in a way that is similar to, consistent with or even repeating what another person defending option C would do. An emotional position associated to the defense of claim C emerges in discourse, ep(C). Its counterpart for people defending the rival option –C is the emotional position ep(-C). Here, the collective configuration does not refer to the material group, but to an *ad hoc* entity based on intellectual affinity. It might group two students sitting at the same table with students sitting at other tables, for instance. At the class level, sides arise in the debate, opposing students with different argumentative claims and associated emotional positions. Each time a participant contributes to the debate in favor of option C (or –C), his discourse will be argumentatively orientated toward C, through an emotional *phasic* move toward ep(C) (or ep(-C)).

3.3 Social and cognitive functions of emotions in collective reasoning: outcomes

In terms of outcomes, what happens on the social and the cognitive dimensions is actually integrated in the overall features of the debate. On the cognitive plane, the sum of the *phasic* emotional moves resulting from turn-taking between people defending competing options gives an overall emotional framing to the debate. A resulting *thymic* tonality emerges, which can be different from the preexisting emotional framing due to the formulation of the problem. On the social plane, the type of group talk impacts the quality of the arguments used, in terms of complexity and dialogism. When *exploratory talk* occurs, for instance, the students are able to render their initial ideas more complex by integrating others' counter-arguments, and they finally deliver stronger arguments that the whole group feels ownership for.

4. Main contributions and discussion

In this final section, we summarize the key contributions of this article, and discuss the significance of the model that we propose for the theorization of group emotions, especially in terms of implications for pedagogical concerns (4.1). The limitations of the present model are addressed and directions for future work are described (4.2).

4.1 Key contributions and significance of the model

The results presented here show that distinguishing between social, motivational, affective and cognitive dimensions of interactions aimed at reasoning together is not an easy task. For analytical purposes, we find useful to differentiate the social and cognitive functions of group emotions. On the social side, group discourse can present features of different types of talk, corresponding to different types of politeness rules and *facework* (Brown & Levinson 1988). Participants may experience and display emotions related to the way in which their *faces* are engaged in such interaction. These feelings are decisive for the group process of turning either to *exploratory* talk, *cumulative* talk or *disputational* talk (cf footnote 4). On the cognitive side, the emotions in play do not concern the *subjects* (participants) of the interactions directly, but rather the *objects* being discussed. The emotional framing of the problem is inherent to the process of *schematization* (Grize 1996; 1997), which orientates the discourse towards a given argumentative conclusion.

Still, these phenomena are hermetic one to the other, and it is worth addressing the challenge of specifying the relations in a global integrated model. Our first aim was to build conceptual tools appropriate for the study of socio-scientific debates among students, in order to make sense of our international videotaped corpus. Retrospectively, we believe that this conceptual framework has a larger relevancy and deserves to be defined as a general theoretical approach of the functions of emotions in collective reasoning, able to address together its cognitive, social and affective aspects, which might be useful to analyze other argumentation in other contexts. This model might be useful to describe any situation in which a group is expected to reason together, either in educational of professional settings.

Nevertheless, our main concern continues to be educational issues, and we would like to insist on a few implications of such model in terms of pedagogical design. First, we are doubtful about the potential gain of artificially separating emotions from "cognitive processes", as some approaches in the field of emotion regulation seem to be targeting (e. g. Järvenoja & Järvelä 2013). Moreover, understanding the emotions underpinning students' engagement in more or less valuable forms of talk for educational goals is promising for designing tools that could foster high quality student interactions. This also raises the matter of creating educational environments that would favor optimal *thymic* framing. Such reflection could have an impact on both the choice of topics and contextualization of a given knowledge content, and on activity's rules and *scripting* (Weinberger 2003, Dillenbourg & Jermann 2007).

4.2 Limitations and directions for future work

The proposed model has proved useful to deeply analyze our data and formulate more general hypotheses on the relations between social and cognitive functions of emotions in groups trying to reason together. Nevertheless, future study must more precisely address the relationship between social and cognitive functions of emotions in argumentative interactions. For example, it might be interesting to question whether a specific type of group talk is associated to a specific level of *thymic* intensity.

Like any model attempting or claiming a form of universality, our proposition also presents a risk of underestimating cultural and contextual factors. In our corpus of interactions taking place in three different countries (Mexico, the US and France), cases of *exploratory* talk and extensive use of emotions to argue, on the cognitive side, were both found in each place. But studies in other linguistic and cultural contexts might be useful to refine or adapt the model to a greater degree of generality.

At the theoretical level, the matter of building a global understanding of how cognitive, social, and affective dimensions of reasoning are integrated also requires further work. Our modest proposition needs to be discussed through, enriched by and articulated with viewpoints coming from different, complementary, fields and disciplines. As any model, our model is characterized by simplifications: they have the advantage of clarifying social and cognitive functions of emotions and underlying processes. Deeper understanding of authentic complex reasoning processes will inevitably bring revisions of our categories and adjustments of their boundaries. For instance, a common argumentative practice is the use of ethos-based strategies to defend a claim. In such discourse, the distinction between the *subjects* and *objects* of conversation vanish, since subjects themselves become, to a great extent, *discourse objects*. Studying this type of frontier case would facilitate a better understanding of how cognitive and social functions of emotions are intertwined.

Appendices

Appendix 1: Transcript conventions

Here are detailed the main transcript conventions used in this article:

1 SPE blabla	number of the turn, first three letters of speaker's name, utterance
[	beginning of speech overlap
:	elongated sound
<((laughing)) uterrance>	commentaries on simultaneous coverbal behaviour
&	continuation of a speech turn
=	rapid succession of words/sounds
((turn))	non-verbal turn (laugh, gesture, etc)

xxx	inaudible segment
/ or \	raising or falling intonation
(word)	uncertain transcription
°word°	low voice or very low voice (°°word°°)
WORD	augmented volume
‘	non standard elision
(.) or (0.8)	pauses either not timed or timed in seconds (lasting 0.8 s)
(…)	discontinuity in turn taking

Informed consent: Informed consent was obtained from all individual participants included in the study.

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