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Abstract

The argumentative theory of reasoning (Mercier & Sperber, in press-c) claims that reasoning evolved for argumentation: to find and evaluate arguments in dialogic contexts. The theory has drawn most of its supportive evidence from work with adults, leaving open the possibility that argumentative features of reasoning are in fact entirely learned. Evidence is reviewed here suggesting that the special relation between reasoning and argumentation holds at all ages. More specifically, it is argued that (a) children possess at least rudimentary argument skills, (b) they are able to reap the benefits of social reasoning from very early on, (c) confirmation bias is present as soon as they start to argue, and (d) children can be victims of the same biases that affect adults when they use reasoning in the wrong contexts. These claims strengthen the argumentative theory of reasoning and support a call for more research on the interactive features of reasoning in both adults and children.

Keywords

reasoning, argumentation, group reasoning, collaborative learning, confirmation bias

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Reasoning serves argumentation in children

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Abstract

The argumentative theory of reasoning claims that reasoning evolved for argumentation: to find and evaluate arguments in dialogic contexts. The theory has drawn most of its supportive evidence from work with adults, leaving open the possibility that reasoning's argumentative features are in fact purely learnt. In this article evidence is reviewed suggesting that there is a special relation between reasoning and argumentation as soon as children start to reason. More specifically, it will be argued (i) that children possess basic argument skills, (ii) that they are able reap the benefits of group reasoning from very early on, (iii) that the confirmation bias is present as soon as they start to argue and, (iv) that children can be victims of the same biases that affect adults when they use reasoning in the wrong contexts. These results strengthen the argumentative theory of reasoning, and support a plea for more research on the interactive features of reasoning both in adults and children.

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“The social need to share the thought of others and to communicate our own with success is at the root of our need for verification. Logical reasoning is an argument which we have with ourselves, and which reproduces internally the features of a real argument.”

(Piaget, 1928, p. 204)

There is an old tension in philosophy and psychology between individual and social views of intelligence. In modern psychology it seems as if the individual view has become dominant, at least in terms of the methods used to investigate intelligence. Participants are asked to solve problems, to make decisions, to evaluate logical arguments, more often than not in isolation. Reasoning in particular is supposed to help the individual overcome her faulty intuitions (Kahneman, 2003) and solve novel problems (Evans & Over, 1996; Stanovich, 2004), without inputs from the social world playing any particular role. Room is often made for social intelligence, but it is generally seen as a distinct set of faculties, comprising for instance, perspective taking, theory of mind and empathy (Goleman, 2006).

At least since the ancient Greeks, voices have raised the possibility that intelligence and, more specifically, reasoning is in fact a profoundly social ability (see Billig, 1996). Over the last century, the most illustrious of these voices have come from developmental psychology. Baldwin saw “no invention without some social reference” (1906, p. 288). Vygotsky stated that “every function in the child’s cultural development appears twice: first, on the social level, and later, on the individual level.” (1978, p. 57). And Piaget believed that “social interaction is a necessary condition of the development of logic” (1976, p. 80; quoted and translated in Doise & Mugny, 1984, p. 19). Despite these pleas to take into account the social dimension of reasoning, developmental research on reasoning still often assumes that its object of study is mostly an individual ability, even if one that can also be put to use in social contexts.

In adult psychology as well some scholars have suggested that reasoning might be a social trait. Billig has emphasized the role of rhetoric and persuasion in social psychology (Billig, 1996). Graff has insisted on the importance of engaging students

through teaching debates and controversies (Graff, 1993). Moral psychologists (Bloom, 2010; Haidt & F. Bjorklund, 2007) and philosophers (Gibbard, 1990) have pointed out the importance of argumentation and debates for moral reasoning. Still reasoning is considered by most to be an individual skill (Evans & Over, 1996; Kahneman, 2003; Stanovich, 2004).

The argumentative theory of reasoning is a recent attempt to show that reasoning is a fundamentally social ability (Mercier & Sperber, in press-a). It claims that reasoning has evolved to serve argumentive ends: finding and evaluating arguments in a dialogic context. In the following section, the theory and the main arguments supporting it are briefly reviewed. This section also articulates more precisely the role of developmental evidence for such an evolutionary theory and specifies the scope of the current article. Sections 2, 3 and 4 are dedicated to a review of evidence showing that reasoning is for argumentation in children as it is in adults.

1. The argumentative theory of reasoning

1.1 Intuitive and reflective inference

Dual process theories have become the dominant framework in the psychology of reasoning (for work on adults, see Evans, 2008, and for developmental work, see Klaczynski, 2009, Reyna & Brainerd, 1995). In spite of this convergence there is still a great deal of vagueness in the characterizations of the two kinds of processes. Mercier and Sperber have attempted to sharpen the distinction by defining and contrasting *intuitive* and *reflective inferences* (Mercier & Sperber, 2009). Inference is to be understood here in its more general meaning of a psychological process that takes an input, processes it, and delivers an enriched output. Inferences are the usual stuff of cognition, from perception all the way to higher processes such as reasoning. In intuitive inferences, no attention is paid to the reasons for which the inference is drawn. When Peter enters a subway station and sees people on the platform, he infers that they are waiting for the train. This inference is spontaneous; he does not realize that its output was delivered on the basis of certain input related to the present situation and to his general knowledge about people's behavior. Intuitive inferences can be very rich and

sophisticated, but people are not normally aware of the reasons that justify their drawing them.

In reflective inferences, by contrast, reasons for drawing a conclusion are pondered. Among the people on the platform is a man with a security uniform. Is he simply waiting for the train, or is he watching over this area? Peter can start thinking about this, reflecting upon the evidence for the two hypotheses. The uniform supports the latter hypothesis, but his behavior is inconsistent with that conclusion: he is sitting, not paying particular attention to his surroundings. So, perhaps he is just taking a break but still not waiting for the train. Peter decides that the evidence is inconclusive and waits to observe his behavior as the train approaches. In this case, Peter can easily state the reasons on the basis of which he drew a given conclusion. Reflective inferences are concerned with such evidential or logical relationships among representations: is a given representation (the premise) a good reason to accept another representation (the conclusion)? In the remainder of this article *reasoning* refers *only* to this very specific type of inference while *intuition* is used for intuitive inferences generally.

1.2 The argumentative function of reasoning

Why are humans, alone in the animal kingdom, able to reason? Dual process theories often point to reasoning's epistemic and practical advantages. Reasoning should help us create new beliefs, generate knowledge, and drive us towards better decisions. Appealing as this view may be, it faces significant problems that can only be briefly summarized here (but see Mercier & Sperber, 2009). The first problem is that, on the one hand, intuitions are very powerful and successfully guide most of our inferences and decisions while, on the other hand, reasoning is slow and costly. The second and more serious problem is that reasoning is itself far from being foolproof, with educated adults being confused by simple logical problems (Evans, 2002) and reasoning being the cause of many a poor decision (Kunda, 1990; Shafir, Simonson, & Tversky, 1993). If intuitions bring, overall, good outcomes, while reasoning is not very efficient at correcting flawed intuitions, it should lead us to question the idea that reasoning evolved to that end.

In contrast to the view of reasoning as a tool of individual cognition, Sperber has suggested that it may have evolved mainly for *argumentative purposes* (Sperber, 2001).

The evolutionary argument can only be sketched here (see Mercier & Sperber, in press-a). Humans rely on communication to an unprecedented extent within the Primate order. Communication, however, is hard to maintain evolutionarily: senders usually have incentives to lie, deceive and manipulate receivers. If receivers do not benefit from communication, they stop receiving, thereby threatening the stability of communication. So receivers evolve mechanisms of epistemic vigilance that allow them to accept information discriminately (Sperber et al., 2010). One of the means that can be used is to exchange arguments. Senders provide reasons supporting their claims, and receivers can evaluate these reasons. Arguments allow for more efficient communication: claims that would otherwise have been automatically rejected can now be defended and properly evaluated. While some are still rejected, others are found to be well supported and accepted. Therefore, both senders and receivers benefit from the exchange of reasons: senders get more messages across, and receivers have a finer-grained mechanism to evaluate communicated information. In this view, reasoning is the cognitive ability that evolved in order to help senders find reasons and receivers evaluate them. This makes of reasoning a fundamentally argumentative, social device. Even though the gist of the argumentative theory is that reasoning evolved mostly to serve argumentative purposes, it is always possible that it also evolved or was co-opted for other ends. Accordingly, argumentation will be referred to as the ‘main’ function of reasoning.

Evolutionary stories are bound to remain speculative and incomplete. Yet it is possible to use an array of evidence to defend their plausibility and test them against competing hypotheses. A fit between structure and function should be expected for any evolved mechanism—including cognitive devices. Thus, it is possible to use the argumentative theory to make predictions about the way reasoning should work, predictions that can be tested through experimental psychology on modern human participants. The main predictions are the following (see Mercier, in press-a, in press-b; Mercier, submitted-a, submitted-b, Mercier & Landemore, in press; Mercier & Sperber, in press-a; Sperber & Mercier, in press, for elaboration and references):

- If reasoning evolved to find and evaluate arguments, the most straightforward prediction is that people should be able to accomplish these tasks well enough—at least in the contexts in which reasoning evolved to work, namely when

participants are engaged in a discussion. There is good evidence that adults exhibit good informal argumentive skills; they can discern good from bad arguments, spot fallacies, create complex arguments and follow commitments and burdens of proof.

- A second straightforward prediction is that reasoning should be more efficient in argumentive contexts, much like our breathing apparatus functions better under the conditions in which it evolved, as opposed to, say, water or high altitude. This is indeed the case. When participants are motivated to create arguments, they have recourse to logical structures, such as *modus tollens* that are deeply problematic in non-dialogic contexts. When they have to discuss a task as a group, participants reach very good results on the same tasks at which they fail abysmally when reasoning on their own.
- When we are engaged in a discussion, we mostly want arguments for our side or against the position of our interlocutor. Thus, the argumentative theory of reasoning predicts that a bias towards this type of arguments should be a feature of reasoning when it produces arguments. And indeed the confirmation bias is one of the most prevalent and robust biases observed in reasoning.
- When people reason about a decision they have already made or a conclusion they have already reached, the confirmation bias should lead to motivated reasoning and, in turn, to epistemically, practically or morally dubious outcomes.
- Finally, when reasoning is used in decision making, it should lead people towards decisions that are easy to justify—decisions for which they can find reasons—rather than good decisions. Sometimes, these easy to justify decisions will not be the best decisions.

1.3 The role of developmental evidence

A large amount of evidence supports the argumentative theory of reasoning. However, all the evidence reviewed in previous articles comes from work with adult participants. Given that the argumentative theory of reasoning is at heart an evolutionary theory, it is crucial to show that the features it predicts do not simply result from a pure learning process. One can clearly not conclude from undergraduates' reading skills that reading is an evolved ability. Could the features listed above be learnt? Children could learn to put their reasoning skills to use in argumentation long after these skills have developed.

Reasoning could be more efficient in group because adults are simply more used to working in groups. The confirmation bias could emerge when children realize that they win more arguments when they only use arguments supporting their side. The negative side effects of reasoning could then result from the misuse of reasoning skills that were not designed to argue in the first place. It is therefore crucial to show that all of these features of reasoning are not purely the result of a learning process. A way of doing so is to look for evidence in children. If all the features of reasoning listed are present in children, and do not seem to develop out of individual abilities, then a substantial hole in the evidence supporting the argumentative theory will be filled.

While a broad range of evidence is reviewed, the scope of the article is limited and focused on furthering an evolutionary, or *ultimate* theory of reasoning. Tinbergen famously described 4 levels of analysis that can be used when investigating biological phenomena (Tinbergen, 1963). The ultimate level bears the function of a biological structure: why did it evolve, what is it adapted for. Phylogenetic level enquiries deal with evolutionary history of a trait: when did it evolve, what are its antecedents. The proximal level is that of mechanisms: how does the structure work. Finally, the developmental level explains how the structure comes to reach its shape during development. These levels of analysis are not competitors, they are complementary (for an example of integration, see D. F. Bjorklund & Pellegrini, 2002).

When it comes to recently evolved human traits, phylogenetic evidence is likely to remain scant, and hypotheses tentative. On the other hand, proximal and developmental theories have been the focus of nearly all the research in psychology, and the domain of reasoning is no exception. Rich theories detailing the working and development of reasoning have been put forward, and these theories have consequences not only for one another but also for ultimate level theories. The present focus on an ultimate level analysis in no way entails that the other levels are any less important, or that the argumentative theory cannot make predictions for other levels.

Importantly, a focus on the ultimate level of analysis does not mean that the role of development should be downplayed (see Kuhn, in press, and, for a reply, Mercier & Sperber, in press b). Claiming that a mechanism is an adaptation does not mean that no development is necessary. Language offers a good example: is it perfectly possible to

think that language is an adaptation without denying that it needs to develop and that a lot of learning goes on throughout this developmental process. The same goes on for reasoning and argumentation. The view defended here is that reasoning is an adaptation for argumentation but that it still needs to develop to reach a stage of adult competency.

As a result, the present article focuses on showing that reasoning in children already bears the mark of its argumentative function, a crucial piece of evidence for the argumentative theory. The predictions of the argumentative theory are evaluated in the order in which they have been listed above. Section 2 defends children's argumentative skills, demonstrating that children possess argumentative skills from very early on. These argumentative skills bring the most benefits when children reason and solve problems in group, as shown in Section 3. For reasoning to best serve argumentative purpose, it should produce arguments following a confirmation bias. Section 4 reviews evidence of the confirmation bias starting as early as children start to reason and argue. It also covers other reasoning biases explained by the argumentative account.

2. Children's argumentative skills

The first and most straightforward prediction of the argumentative theory is that people should have enough argumentative skills to be able to take part in informal arguments. Moreover, children should not have to learn argumentative skills entirely, and some of these skills should develop at least as early as other reasoning abilities.

In order to engage in informal arguments only relatively basic argumentative skills are required. People must be able to construct and evaluate simple arguments and not to build the complex and lengthy arguments found in books or essays. They do not have to recognize argument forms or to draw argument schemas—as language users do not need to be able to explicitly recognize what a subject is or to draw syntactic trees. The minimal skills that are predicted to be present in children and adults are therefore likely to leave many unsatisfied. They are certainly not sufficient to make a good essayist or a consumed debater, in the same way as speaking a language does not make one a novelist or a poet. It could also be argued that these basic skills are not even sufficient for modern citizens, surrounded by complex information sources and expert arguers. The focus on different levels of argumentative skills, from the simplest—giving an argument—

to the more complex—building a complex attack that anticipates the listener’s rebuttals—explains in part the many contradictory results found in this literature (contrast for instance, Resnick, Salmon, Zeitz, Wathen, & Holowchak, 1993 to Kuhn, 1991). The focus here is on the basic skills necessary to engage in an informal discussion, as it is only the mastery of these skills that is predicted by the argumentative theory.

4.1 Understanding and evaluating arguments

The first important source of data is the study of parenting style. Hoffman suggests categorization of parenting techniques that stress the importance of reasoning, that is, of providing arguments to convince children that they should perform or not perform a given action (Hoffman, 1970a, 1970b). Parents who use reasoning in such a way are more “successful in promoting resistance to temptation, guilt over antisocial behavior, reparation after deviation, altruism, and high levels of moral reasoning” (Grusec & Goodnow, 1994, p. 5). These results, however, could still reflect a blind acceptance of arguments on the part of the children rather than critical evaluation. That does not seem to be the case. Grusec and Goodnow (1994) argued for a two-step approach: first comprehension and then evaluation. Most relevant here is that the second step does not follow necessarily from the first: children can understand an argument perfectly well and then reject it: children can state their parents’ positions while still holding on to their own views.

The domain in which the influence of different arguments has been the most thoroughly studied is that of moral behavior and moral reasoning. Based on Turiel’s classic distinction between the moral and conventional domains (Turiel, 1983), Nucci and Killen conducted a series of studies testing children’s perception of the appropriateness of arguments pertaining to these two domains (Killen, 1991; Nucci, 1984). Their participants, from preschoolers to adolescents, had to rate the reactions of teachers as they were confronted with violations in the moral or in the conventional domains. The reactions that were ‘domain appropriate’ elicited higher ratings from the children. Other studies have observed directly children’s behavior following different injunctions to perform a moral act, such as sharing toys or candies. It was observed that children do not indiscriminately accept any argument. ‘Empathic’ arguments (e.g., “[poor

children] would be so happy and excited if they could buy food and toys...”) were much more efficient than ‘normative’ arguments (“we should give some money to others poorer than ourselves...”) (Eisenberg-Berg & Geisheker, 1979). Moreover, children (7 to 10 years old) are sensitive to the intensity of the feelings being described (Kuczynski, 1982). Nine-year-olds also respond to arguments invoking abstract rules or the transgressor’s intentions (e.g., LaVoie, 1974). Interestingly, arguments are much less effective when they target the child’s own emotions, as in “if you share your toys, you will be very happy.” In that case, children can evaluate the statement—they know how they feel when they engage in a pro-social action and realize that the premise may not be completely true (Kuczynski, 1982).

Children’s ability to discern good arguments from poor ones is not limited to the domain of morality. Faced with standard conservation tasks, second graders are much more likely to be persuaded by the arguments of a conserver than by those of a non-conserver (Miller & Brownell, 1975). Again, in this case they are not simply following some sort of authority because the conservers’ arguments regarding any other questions are not as likely to be persuasive. That children are selectively swayed by good arguments is also shown by the results from collaborative learning and reasoning reviewed in Section 3.

Children and adolescents possess other valuable argumentative skills. For example, 6-year-olds are sensitive to circular arguments (Baum, Danovitch, & Keil, 2007). High school students are able to spot all sorts of fallacies (Klaczynski, 1997; Neuman, 2003; Neuman, Weinstock, & Glasner, 2006; Weinstock, Neuman, & Tabak, 2004). So it does seem that children, even at a very young age, can not only understand but also evaluate arguments, and that these skills continue to mature as children grow older.

4.2 Producing arguments

There is now a wealth of data on early justifications, explanations and arguments. Several studies have shown that as soon as toddlers can utter sentences, at around 18 or 24 months of age, they use them to justify their violations or try to argue with their parents or their siblings (Kuczynski & Kochanska, 1990; Kuczynski, Kochanska, Radke-

Yarrow, & Girnius-Brown, 1987; Perlman & Ross, 2005). For instance, a child could justify her refusal to pick up her toys by stating that “No. I tired,” or reclaim a toy from her sibling with the justification that “that doesn't belong to you” (Dunn & Munn, 1987, p. 793). By 3 years of age, children are able to “generate and think about positive and negative reasons for pursuing different courses of action or for holding specific sets of beliefs” (Stein & Bernas, 1999, p. 97). They can also have recourse in argumentation to social rules, to the material consequences of actions or the consequences for the others’ feelings (Dunn & Munn, 1987). In the course of making these arguments, children use logical structures that remain obscure, in their abstract forms, to adult participants (such as the *modus tollens* used by 4-year-olds: Scholnick & Wing, 1991).

Thus children can use a wide variety of argumentive tactics in the course of negotiations or justifications. But, are the arguments they use appropriate and are these tactics successful? In the moral domain, children use different arguments depending on the kind of violation (conventional or moral) that has been committed (Nucci, 1985). For instance, preschoolers do not try to challenge moral rules, like saying that stealing is right generally; instead they argue that they had been wronged by the victim before or that the toy was theirs all along (see Brenneis & Lein, 1977; Goodwin, 1983; Maynard, 1985). Five-year-olds can also produce elaborate causal explanations as arguments (Orsolini, 1993a, 1993b; Orsolini & Pontecorvo, 1992). These more felicitous or complex arguments tend to lead to successful conflict resolution. The better the children are at constructing arguments, the greater the likelihood that they will successfully put an end to a conflict (e.g., Ram & Ross, 2001).

All of these results may seem to be at odds with the message of many psychologists and educators that urge for more teaching of argumentive skills (Kuhn, 2005; Perkins, Farady, & Bushey, 1991). If children are naturally good at argumentation, what is left to teach? First, it is important to emphasize that even though argumentive skills may have an evolutionary basis, they do not emerge fully fledged. Some tactics, such as attacking a particular point in an interlocutor’s argument, are only common in teenagers (Berkowitz & Gibbs, 1985). Moreover, as pointed out earlier, the basic argumentive skills that should develop mostly naturally in the course of conversations might not be deemed appropriate for all purposes. But there are also reasons why children (or adults) can seem to be less argumentatively skilled than they are.

The first factor that should be taken into account when evaluating spontaneous argumentative skills is that reasoning cannot be expected to find the best arguments from the start. According to the argumentative theory, reasoning evolved to help us find and evaluate reasons in argumentative contexts. These contexts have the particularity of allowing speakers to try several arguments in order to make their point. A failure at the first attempt is nearly costless: a second argument can always be put forward; there is no need to overshoot by finding a foolproof argument on the first try. Thus, reasoning should display a very high degree of *satisficing*: it should not look for the best arguments but for one that are good enough (Mercier, submitted-a). This is one of the reasons why observers are often dispirited by the level of naïve adult participants' arguments (e.g., Kuhn, 1991; Perkins, 1985). In most experimental settings, participants do not have an interlocutor who would force them to find better arguments by refusing to accept or rebutting their initial attempts. The most natural way to force people to construct better arguments is to offer counter-arguments, something that happens spontaneously in groups and explains in part their better level of reasoning performance. But the quality of argument can also be improved by setting high standards for students' explanations and by asking them to elaborate on their arguments (Anderson, Chinn, Chang, Waggoner, & Yi, 1997; Anderson, Chinn, Waggoner, & Nguyen, 1998; Lin & Anderson, 2008; Webb et al., 2008).

A related reason for the poor performance in standard tasks is the lack of a good motivation to argue. According to the present view, reasoning is triggered by the need to convince or by the evaluation of arguments supporting a claim deemed to be relevant. Appropriate motivation is crucial for children to deliver good arguments. Thus, Stein and her collaborators were able to observe the production of felicitous reasons in 3-year-olds because the exchanges were “personally meaningful to young children and ... impact[ed] directly on their goals, beliefs, and well-being” (Stein & Bernas, 1999, p. 97). All the data showing the production of justifications and arguments in very young children also arises from conflict resolution or negotiation situations. It should come as no surprise that when children are put in situations in which they may not be motivated to convince someone—when, for instance, they have to support a mathematical result—they are much less likely to come up with good justifications. But children, as adults, can

sometimes be made to care about defending their point of view simply by being put in a group with people who do not share their point of view.

5. Collaborative learning and reasoning

5.1 The benefits of collaborative reasoning and learning

According to the present theory, reasoning should be at its best in argumentive contexts. Such contexts naturally arise from a disagreement in a group willing to work together—this is the kind of context for which reasoning, it was suggested, evolved. Reasoning should be activated more easily, and should be more efficient in such contexts, much in the same way as color vision is at its best in broad daylight. There is now a wealth of evidence supporting this hypothesis. Indeed, “research on cooperative learning is one of the greatest success stories in the history of educational research” (Slavin, 1996, p.43).

Two main traditions have shown that collaborative reasoning and learning can bring important cognitive benefits. The first is a neo-Piagetian research program that sees socio-cognitive conflict as playing a crucial role in the development of children’s reasoning abilities (see Doise & Mugny, 1984; Perret-Clermont, 1980; Perret-Clermont et al., 2004). It relies substantially on the following paradigm: children have to solve a task individually (pretest); they are confronted with the same task in pairs (test), before finally solving the task individually again (posttest). The most important parameter is the way children are paired with each other: a conserver can be paired with a non-conserver, or a non-conserver of a given type with a non-conserver of another type. Children could also face an adult who tells them that they were wrong and why. The most relevant finding is that the interaction very often leads to an improvement in the posttest, compared to a control condition in which children did not interact with a peer. This has been observed for numerous conservation tasks or spatial transformation tasks, at early as 6 years of age (see for instance, Doise & Mugny, 1984; Perret-Clermont, 1980). The benefits of collaboration for this kind of task are extremely robust.

The second tradition that has demonstrated the benefits of collaborative learning comes from education research. Here data is usually gathered through long-term projects in which whole classes are compared. The learning outcomes of students that are urged to cooperate through different means are compared to those of a control

group. Collaboration has been found to have positive effects on learning in a wide range of disciplines—from social studies to mathematics—and ages—from elementary school onwards (see the references in Johnson & Johnson, 2007; Slavin, 1995; Webb & Palinscar, 1996). While, due to their scale, it is difficult to draw conclusions regarding the precise mechanisms at play during the discussions from these studies, they are invaluable for investigating the long-term consequences of collaborative learning.

More recently, these two traditions have merged into experiments that use educational material (science problems for instance) while studying the details of the argumentation taking place within the group and their effect on performances (for a review, see Nussbaum, 2008,). These studies converge with their predecessors in concluding that “collaborative student discourse (i.e., reflective discussions among students about academic content) can sometimes promote deep and meaningful learning” (Nussbaum, 2008, p. 348).

5.2 Arguing as a natural source of motivation

Several theories could account for the improvement in performance observed in group settings. In order to support a specifically argumentative account, I attempt to show that other theories fall short of explaining all the findings. Four alternatives will be distinguished: (i) Groups are simply one source of motivation, equivalent to other motivational factors; (ii) Groups have a particular motivational power but it applies not only to reasoning but to all skills; (iii) Group settings improve performance because they allow students to use their natural pedagogical abilities; And (iv), group settings improve performance because they provide the motivation and the normal context for the use of reasoning as an argumentative mechanism—the hypothesis defended here.

(i) The most general motivational explanation that can be formulated is that groups are simply one source of motivation, among many others. This explanation is easy to refute. Children are surrounded by all kinds of motivating factors: their parents, teachers and peers can all motivate them to perform well. Yet these motivating factors do not boost performance in the same way as group settings. Some forms of motivation, such as external rewards, can even have negative effects (Deci, Koestner, & Ryan, 2001;

Deci, Vallerand, Pelletier, & Ryan, 1991). Hence, there seems to be something specific about group settings.

(ii) Even if groups have a particular motivational power, it could still be that this motivational power is not specific to reasoning. Groups could provide a special motivation to perform better in a whole range of tasks, and reasoning could be only one of many psychological mechanisms responding to this motivation. This explanation is hard to reconcile with the fact that groups—including groups of children—tend to perform very poorly on a wide range of tasks (for children, see Slavin, 1995; Webb, 1997). But the adverse effects of collective work mostly affect groups facing non-intellective tasks—tasks in which argumentation cannot be involved: “peer collaboration is an effective learning environment for tasks that require reasoning, but not for tasks that require rote learning or copying” (Phelps & Damon, 1989, p. 639, see also Barron, 2003, Schwarz & Linchevski, 2007). Thus, it seems that the motivation brought about by group settings is doubly specific: it cannot easily be substituted for by other sources of motivation, and it does not affect other skills as it does reasoning.

(iii) Several scholars have suggested that humans are endowed with natural pedagogical skills (Csibra & Gergely, 2009; Sterelny, in press). It is still possible that groups improve performance because they provide a natural context for the deployment of these skills. Several facts provide arguments contrary to this interpretation. First, the typical student-teacher interaction should be close to a perfect learning context for a pedagogical device: a more knowledgeable individual delivers well crafted explanations to a less knowledgeable individual whose performance depends on this understanding. However, this is specifically the baseline that education researchers are trying to improve on. Even when students can teach other students the results are disappointing. Group collaboration in school sometimes fails to yield good results in posttests despite good test results, even in intellective tasks. This happens when some students are ‘free-riding’ during the test, letting the more competent students solve the task (e.g., Webb, 1993). This is difficult to reconcile with the notion of a natural propensity for pedagogy. In this situation, the students clearly recognize the presence of more competent and less competent group members, but they still fail to provide or to attend to explanations. A solution is to artificially make the result of the group dependent on the result of each of its members in the posttest. In fact, in group settings, the use of this method seems to be

indispensable: “Use of group goals or group rewards enhances the achievement outcomes of cooperative learning *if and only if* the group rewards are based on the individual learning of all group members” (Slavin, 1996, p. 45, italics added).

(iv) Even if other explanations have been ruled out, the argumentative theory still has to account for all the aforementioned findings. In particular this later finding—that some groups need special rewards to perform well—may seem to contradict the view adopted here: why do all groups settings not spontaneously lead to felicitous reasoning? From the present point of view, the use of such artificial props is made necessary by the lack of argumentative stake in these tasks. Simply having to reason in a group is not sufficient: one has to be willing to defend an opinion and this may not always be the case. It is only when students have something to argue for or against that they become skilled arguers. Thus, while “true argumentation on scientific issues is difficult to sustain and rarely occurs” (Schwarz & Linchevski, 2007, p. 511), “students are extremely skilful at (counter-)challenging, conceding, etc. during conversation ... when discussing everyday issues” (Schwarz & Glassner, 2003, p. 228.). According to the present theory, it is not the intrinsic difficulty of scientific theories that creates problems for students but the fact that students tend not to be strongly opinionated about many school topics. In line with this interpretation, one study observed that when elementary school students became “passionately engaged” in an otherwise arcane argument, they “used evidence in scholarly ways, developed several arguments, and generated questions regarding biological classification” (Engle & Conant, 2002, p. 399, for a review of similar studies, see Nussbaum, 2008).

Another way to create an argumentative stake is to use groups of participants who tend to give different answers according to a pretest, and who thus have an opinion to defend against other points of view. Using Piagetian conservation tasks—in which everyone has an opinion because the tasks tap into common intuitions—as well as a variety of other cognitive problems, studies have shown that groups that initially disagree over the solution can achieve significant cognitive gain, both in the test and in the posttest, starting in elementary school or even kindergarten (see for instance, Buchs & Butera, 2004; Doise & Mugny, 1984). In the most dramatic cases, the groups, or at least some of their members, attained levels of performance exceeding that of the best member in the pretest. For instance, two non-conservers who make different kinds of

mistakes can achieve conservation when they have to argue with each other—a phenomenon known as the ‘two wrongs make a right’ that can already occur with 6-year-olds (Ames & Murray, 1982; Doise & Mugny, 1984; Glachan & Light, 1982; Schwarz, Neuman, & Biezuner, 2000).

It is interesting to notice that the literature on group reasoning and decision making shows overwhelming positive outcome with children while providing many negative results for adults. In particular adult group reasoning is often plagued by ‘groupthink’ (Janis, 1982) or ‘group polarization’ (Sunstein, 2002), which is the tendency to stifle dissenting voices and move towards more extreme opinions. Group polarization typically occurs when all group members agree to start with. They then use reasoning to find arguments supporting their current opinion, arguments that are not critically examined since everybody agrees with their conclusion (Mercier & Landemore, in press). But arguments and debates stem from disagreements: it usually takes an artificial context to make people argue over something they agree about. Adults are often studied in such artificial contexts, such as mock juries or other groups that have to justify their decision even if it is unanimous. By contrast, children are mostly tested when facing problems about which they either disagree or, if they agree, they may not be expected to provide justifications for their answers, and so they do not have to argue.

I have tried to show that the present theory is in a good position to explain the performance of groups as far as reasoning is concerned. It can account for group successes—when there is a genuine disagreement leading to a constructive discussion—and group failures—when there is no disagreement or no argumentative stakes. Moreover, the argumentative theory is in a unique position to explain how the confirmation bias can be held in check by groups discussing together.

4. Reasoning biases

4.1 The confirmation bias

The confirmation bias is one of the most robust and prevalent bias observed by psychologists (Nickerson, 1998). Classical theories of reasoning tend to explain this bias away as a result of our cognitive limitations. Falsification would require more cognitive skill or energy than is usually available. The classical account, however, is hard to

sustain in the face of the empirical evidence showing that people can be very skilled falsifiers *when they want to prove someone (or an idea) wrong* (see Mercier & Sperber, in press-a). On the other hand, this pattern of result is most straightforwardly explained if reasoning is an argumentative device. When engaged in an argument, we should mostly look for arguments that support our position or rebut that of our interlocutor. In this perspective, the confirmation bias is not a flaw but an evolved *feature* of reasoning. However, it could be that the confirmation bias is the result of learning. Reasoning could start out as a fairly objective mechanism for producing arguments before people understand, as they engage in more and more discussions, that providing arguments for the other side is not an efficient strategy.

Results from the developmental literature show that children are biased from the very beginning. Stein and Albro, reporting results from children as young as 3-years old, conclude that “arguers of all age levels, from preschool to adulthood, ... exhibit similar biases in their understanding and memory for a conflict, independent of their age.” (Stein & Albro, 2001, p.130). Likewise, Ross and her colleagues note that “siblings between 4 1/2 and 9 1/2 ... evidenced self-serving biases, ascribing positive actions to themselves more than to their siblings.” (Ross, Smith, Spielmacher, & Recchia, 2004, p. 61). These siblings also “spontaneously explained ... their negative actions” or excluded them from their reports (ibid, p. 61). In another study it was found that the large majority of 9-year-olds’ utterances supported their own point of view (Pontecorvo & Girardet, 1993). It is important to stress that this early emerging confirmation bias does not entail a lack of ability to attack arguments—when they are the arguments of the other party in the conflict (Howe, Rinaldi, & Jennings, 2002; Tesla & Dunn, 1992).

One could argue, however, that observing such biases in situations of conflict is only to be expected. But the confirmation bias is also observed when the context would seem to call for a more objective evaluation of arguments. Thus, Garcia-Mila and Anderson (2008) point to the confirmation bias as one of the main obstacle to be overcome for a successful science education, even though learning scientific theories is typically less emotion inducing. Again, this should not be interpreted as a lack of critical thinking, for students can use a wide variety of strategies to discount evidence that contradicts their beliefs (Chinn & Brewer, 1998). Klaczynski and his colleagues have shown that adolescents only become proficient at finding flaws in arguments when the

conclusions of these arguments contradict some of their previously held beliefs (e.g., Klaczynski & Lavalley, 2005).

Results from the developmental literature confirm those obtained with adults. The confirmation bias is prevalent and robust. The failure to falsify does not result from a cognitive deficiency but rather from a lack of motivation, particularly when one is dealing with one's own beliefs. This failure to falsify can be easily overcome when confronted with opposing opinions.

4.2. Motivated reasoning

Motivated reasoning can be a consequence of the confirmation bias. It occurs when we use reasoning not while engaged in an argument but in anticipation of a discussion. For instance, if we have reasons to think that one of our beliefs will be disputed, we may try to proactively find arguments in its support (Kunda, 1990). To the extent that children feel less pressure to justify their beliefs and their actions, they may be less affected by motivated reasoning. Still, when children or adolescents are put in situations that strongly favor the use of motivated reasoning, we should observe the same outcomes as in adults.

A first consequence of motivated reasoning is the creation of rationalizations: arguments that we use to justify our beliefs even though they have no relationship with the actual reason for which we hold our belief. Children are no less apt than adults to have recourse to rationalizations (see for instance, Karmiloff-Smith, 1992, p. 81). Another consequence of motivated reasoning is that all the arguments gathered in preparation of a defense of our beliefs may in fact end up strengthening our beliefs to the point of changing them. Adolescents can see their attitudes polarize in this fashion (Klaczynski, 2000).

Motivated reasoning is also at play in the moral domain, where it allows us to find excuses for behaviors that may violate our moral intuitions (Haidt, 2001). Recent studies involving children's moral decision making in groups show that moral reasoning is linked to persuasion skills (Gummerum et al., 2008; Takezawa et al., 2006). In these experiments, children (11 to 14-year-olds) had to play economic games (the ultimatum game or the dictator game) in groups. For instance, they might have had to decide how

many of twenty 20-cents coins they would allocate to another group that had no opportunity to retaliate or reciprocate (dictator game). The stage of moral reasoning reached by the participants was later assessed. No correlation was observed between these stages of moral reasoning and altruistic behavior: children who had achieved a higher stage had no propensity to give more coins. However, the children who had higher scores of moral reasoning were better at convincing other group members to adopt their suggestion, whether they pushed for altruism or egoism. These results fit in well both with Haidt's theory and with the present framework. This does not mean however that reasoning always plays a negative role in moral development. In particular, group reasoning can sometimes lead to superior moral outcomes (see Mercier, submitted-b).

Aware of the pitfalls of the confirmation bias, many educators have emphasized the teaching of critical thinking skills, but they have only met with limited success (Ritchart & Perkins, 2005; Willingham, 2008; for a counterpoint and a recent exception, see Kuhn & Crowell, in press). This is only to be expected if the confirmation bias is an evolved feature of reasoning, as suggested by the evidence reviewed above. However, the current theory also suggests a way to hold the confirmation bias in check: group discussion. When children have to solve a task together, they are often able to change their mind, sometimes deriving a better solution in the process. In such contexts, the confirmation bias can become a form of *division of cognitive labor*. Instead of having to look for arguments for and against every position, each group member only tries to find arguments for his or her opinion and against that of the others. As long as they are able to evaluate others members' arguments and change their mind if necessary, then the outcome should be felicitous for a minimal cost, not despite but thanks to the confirmation bias.

4.3. Reasoning and decision making

Most dual process theories predict that reasoning, thinking carefully about the pros and cons of different options will lead to better decisions. According to the current proposal, when reasoning is used in decision making, it performs the same function as it does when used in its natural context: it looks for arguments. Accordingly, reasoning should lead towards decisions that are *easier to justify*—decisions for which arguments can be

most easily gathered. An extensive literature in the judgment and decision making field supports this prediction (see Mercier & Sperber, in press-a). To the extent that children are less prone than adults to reasoning before making a decision, the current theory predicts that they should be less likely to fall prey to the mistakes attributed to reason based choice. On the other hand, classical theories of reasoning predict a linear increase in correct responses with the use of reasoning—and therefore with age.

In line with the predictions of the argumentative theory, it has been observed that “children sometimes make better decisions and less biased judgments, and thus may (sometimes) be more rational, than adults.” (Klaczynski, 2009, p. 265-6, see also Reyna & Farley, 2006). At least three mistakes that are due, at least in part, to reasoning follow this pattern. The first is the sunk cost fallacy—the tendency to keep investing time, energy or money into a project because an investment as already been made. Experiments show an increase with age in the percentage of children committing the fallacy (Klaczynski & Cottrell, 2004; Morsanyi & Handley, 2008). The second phenomenon of interest is the attention paid to irrelevant information. While adults feel compelled to justify themselves if they do not take into account everything they have been told in the experiment, children can discount irrelevant information more easily, presumably because they feel less of a pressure to justify themselves (Klaczynski, submitted). Finally, some framing effects have also been explained as reason based choices. It should therefore come as no surprise that some experiments have unveiled a marked increase in framing effects with age (Reyna & Ellis, 1994).

All of these results do not imply that learning and using rules is not a good thing: most rules allow people to reach results that are both justifiable *and* good. This is especially true in the context of formal education because the rules that are taught in school are the result of careful scrutiny and are often valid. Still, it is interesting to note that when there is a dissociation between a good decision and a justifiable one, reasoning tends to pull towards the latter and not the former, as predicted by the argumentative theory.

9. Conclusion

At least in the West, an individual view of reasoning has dominated philosophy since Descartes, and psychology at least since the cognitive revolution. The argumentative theory of reasoning joins other dissenting voices in claiming that reasoning is in fact a fundamentally social and, more specifically, argumentive ability. However, the accumulated support for the argumentative theory suffered from an important defect: it nearly exclusively drew on research with adults. This is problematic since, as an evolutionary theory, the argumentative theory needs to show that the feature of reasoning it predicts are not purely the outcome of a learning process. In this article, evidence has been reviewed supporting the following contentions, which are of interest even if one does not accept the theory they support:

- Children possess basic argumentive skills (Section 2)
- Children spontaneously reason in groups and reap the benefits of collaborative reasoning (Section 3)
- Children's reasoning has a confirmation bias from the start (Section 4.1), which explains the poor consequences of motivated reasoning (Section 4.2)
- Because children reason less than adults in some situations, they can sometimes make better decisions by using reasoning less (Section 4.3)

This research would benefit from being extended in several directions. One is the study of special populations. Populations with known deficits in social cognition would be of particular interest (see for instance, McKenzie, Evans, & Handley, 2010). Populations with specific reasoning problems could provide another interesting comparison point (e.g., Williams syndrome). The present, ultimate level theory should also interact constructively with proximal and developmental theories.

One of the strengths of the argumentative theory is its ability to explain broad trends observed in different domains. By drawing attention to the startlingly similar patterns of reasoning observed in children and adults, it may contribute to a further rapprochement between studies of these two populations. This article can also be taken as another plea to pay more attention to reasoning in interaction, echoing the concerns of many developmental psychologists.

- Ames, G. J., & Murray, F. B. (1982). When two wrongs make a right: Promoting cognitive change by social conflict. *Developmental Psychology, 18*, 894-897.
- Anderson, R. C., Chinn, C., Chang, J., Waggoner, M., & Yi, H. (1997). On the logical integrity of children's arguments. *Cognition and Instruction, 15*(2), 135-167.
- Anderson, R. C., Chinn, C., Waggoner, M., & Nguyen, K. (1998). Intellectually stimulating story discussions. In J. Osborn & F. Lehr (Eds.), *Literacy for All* (pp. 170-196). New York: Guilford.
- Baldwin, J. M. (1906). *Social and Ethical Interpretations in Mental Development* (fourth edition ed.). New York: MacMillian.
- Barron, B. (2003). When smart groups fail. *Journal of the Learning Sciences, 12*(3), 307-359.
- Baum, L. A., Danovitch, J. H., & Keil, F. C. (2007). Children's sensitivity to circular explanations. *Journal of Experimental Child Psychology, 100*(2), 146-155.
- Berkowitz, M. W., & Gibbs, J. C. (1983). Measuring the developmental features of moral discussion. *Merrill-Palmer Quarterly, 29*(4), 399-410.
- Bicknell, J. (2003). Descartes's rhetoric. *Philosophy and Rhetoric, 36*, 22-38.
- Billig, M. (1996). *Arguing and Thinking: A Rhetorical Approach to Social Psychology*. Cambridge: Cambridge University Press
- Bjorklund, D. F., & Pellegrini, A. D. (2002). *The origins of human nature: Evolutionary developmental psychology*. Washington, DC: American Psychological Association.
- Blatt, M. M., & Kohlberg, L. (1975). The effects of classroom moral discussion upon children's level of moral judgment. *Journal of Moral Education, 4*(2), 129-161.
- Bloom, P. (2010). How do morals change? *Nature, 464*(7288), 490.
- Brenneis, D., & Lein, L. (1977). "You fruithead": A sociolinguistic approach to children's dispute seulement. In S. M. Ervin-Tripp & C. Mitchell-Keman (Eds.), *Child Discourse* (pp. 49--65). New York: Academic Press.
- Buchs, C., & Butera, F. (2004). Socio-cognitive conflict and the role of student interaction in learning. *New Review of social Psychology, 3*(1-2), 80-87.
- Chinn, C. A., & Brewer, W. F. (1998). An empirical test of a taxonomy of responses to anomalous data in science. *Journal of Research in Science Teaching, 35*(6), 623-654.

- Clark, R. A., & Delia, J. G. (1977). Cognitive complexity, social perspective-taking, and functional persuasive skills in second-to-ninth grade children. *Human Communication Research*.
- Csibra, G., & Gergely, G. (2009). Natural pedagogy. *Trends in Cognitive Sciences*.
- Deci, E. L., Koestner, R., & Ryan, R. M. (2001). Extrinsic rewards and intrinsic motivation in education: Reconsidered once again. *Review of Educational Research*, 71(1), 1.
- Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational psychologist*, 26(3), 325–346.
- Descartes, R. (1992). *Discours de la méthode*. Paris: Vrin.
- Doise, W., & Mugny, G. (1984). *The Social Development of the Intellect*. Oxford: Pergamon Press.
- Dunn, J., & Munn, P. (1987). Development of justification in disputes with mother and sibling. *Developmental Psychology*, 23, 791-798.
- Eisenberg-Berg, N., & Geisheker, E. (1979). Content of preachings and power of the model/preacher: The effect on children. *Developmental Psychology*, 15(2), 168–175.
- Engle, R. A., & Conant, F. R. (2002). Guiding principles for fostering productive disciplinary engagement: Explaining an emergent argument in a community of learners classroom. *Cognition and Instruction*, 20(4), 399–483.
- Evans, J. S. B. T. (1996). Deciding before you think: Relevance and reasoning in the selection task. *British Journal of Psychology*, 87, 223-240.
- Evans, J. S. B. T. (2002). Logic and human reasoning: an assessment of the deduction paradigm. *Psychological bulletin*, 128(6), 978-996.
- Evans, J. S. B. T. (2008). Dual-processing accounts of reasoning, judgment and social cognition. *Annual Review of Psychology*, 59, 255-278.
- Evans, J. S. B. T., & Over, D. (1996). *Rationality and Reasoning*. Hove: Psychology Press.
- Forman, E. A., & Kraker, M. J. (1985). The social origins of logic: The contributions of Piaget and Vygotsky. In M. W. Berkowitz (Ed.), *Peer Conflict and Psychological Growth* (pp. 23-39). San Francisco: Jossey-Bass Inc Publishers.
- Garcia-Mila, M., & Andersen, C. (2008). Cognitive foundations of learning argumentation. *Argumentation in Science Education*, 35, 29-45.
- Gibbard, A. (1990). *Wise Choices, Apt Feelings*. Cambridge: Cambridge University Press.

- Glachan, M., & Light, P. (1982). Peer interaction and learning: Can two wrongs make a right? In G. Butterworth & P. Light (Eds.), *Social cognition: Studies in the development of understanding* (pp. 238–262). Chicago: University of Chicago Press.
- Goleman, D. (2006). *Social intelligence*. New York: Bantam.
- Goodwin, M. H. (1983). Aggravated correction and disagreement in children's conversations. *Journal of Pragmatics*, 7(6), 657–677.
- Graff, G. (1993). *Beyond the culture wars: How teaching the conflicts can revitalize American education*. New York: WW Norton & Company.
- Grusec, J. E., & Goodnow, J. J. (1994). Impact of parental discipline methods on the child's internalization of values: A reconceptualization of current points of view. *Developmental Psychology*, 30(1), 4-19.
- Gummerum, M., Keller, M., Takezawa, M., & Mata, J. (2008). To give or not to give: Children's and adolescents' sharing and moral negotiations in economic decision situations. *Child Development*, 79(3), 562-576.
- Haidt, J. (2001). The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review*, 108(4), 814-834.
- Haidt, J., & Bjorklund, F. (2007). Social intuitionists reason, in conversation. In W. Sinnott-Armstrong (Ed.), *Moral Psychology* (Vol. 3). Cambridge, MA: MIT Press.
- Hoffman, M. L. (1970a). Conscience, personality, and socialization techniques. *Human development*, 13(2), 90.
- Hoffman, M. L. (1970b). Moral development. In P. H. Mussen (Ed.), *Carmichael's Manual of Child Psychology* (Vol. 2, pp. 261-360). New York: Wiley.
- Howe, N., Rinaldi, C., & Jennings, M. (2002). "No! The lambs can stay out because they got cosies": Constructive and destructive sibling conflict, pretend play, and social understanding. *Child Development*, 73, 14560–11473.
- Janis, I. L. (1982). *Groupthink*. Boston: Houghton Mifflin.
- Johnson, D. W., & Johnson, R. (2007). *Creative constructive controversy: Intellectual challenge in the classroom* (4th ed.). Edina, MN: Interaction Book Company.
- Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, 58(9), 697-720.

- Karau, S. J., & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology*, 65(4), 681-706.
- Karmiloff-Smith, A. (1992). *Beyond Modularity*. London: Bradford Books.
- Kerr, N. L., & Tindale, R. S. (2004). Group performance and decision making. *Annual Review of Psychology*, 55, 623-655.
- Killen, M. (1991). Social and moral development in early childhood. In W. M. Kurtines & J. L. Gewirtz (Eds.), *Handbook of moral behavior and development* (Vol. 2, pp. 115-138). Hillsdale, NJ: Erlbaum.
- Klaczynski, P. A. (2000). Motivated scientific reasoning biases, epistemological beliefs, and theory polarization: A two-process approach to adolescent cognition. *Child Development*, 1347-1366.
- Klaczynski, P. A. (2009). Cognitive and social cognitive development: Dual-process research and theory. In J. S. B. T. Evans & K. Frankish (Eds.), *In Two Minds* (pp. 263-292). New York: Oxford University Press.
- Klaczynski, P. A. (submitted). When (and when not) to make exceptions: Links among age, precedent setting decisions, conditional inferences, and argument evaluation.
- Klaczynski, P. A., & Cottrell, J. M. (2004). A dual-process approach to cognitive development: The case of children's understanding of sunk cost decisions. *Thinking & Reasoning*, 10(2), 147-174.
- Klaczynski, P. A., & Lavalley, K. L. (2005). Domain-specific identity, epistemic regulation, and intellectual ability as predictors of belief-based reasoning: A dual-process perspective. *Journal of Experimental Child Psychology*, 92, 1-24.
- Kuczynski, L. (1982). Intensity and orientation of reasoning: motivational determinants of children's compliance to verbal rationales. *Journal of experimental child psychology*, 34(3), 357.
- Kuczynski, L., & Kochanska, G. (1990). Development of children's noncompliance strategies from toddlerhood to age 5. *Developmental Psychology*, 26(3), 398-408.
- Kuczynski, L., Kochanska, G., Radke-Yarrow, M., & Girnius-Brown, O. (1987). A developmental interpretation of young children's noncompliance. *Developmental Psychology*, 23(6), 799-806.
- Kuhn, D. (1991). *The Skills of Arguments*. Cambridge: Cambridge University Press.

- Kuhn, D. (1992). Thinking as argument. *Harvard Educational Review*, 62(22), 155-178.
- Kuhn, D. (2005). *Education for Thinking*. Harvard, MA: Harvard University Press.
- Kuhn, D. (in press). What people may do versus can do. *Behavioral and Brain Sciences*.
- Kuhn, D., & Crowell, A. (in press) Dialogic Argumentation as a Vehicle for Developing Young Adolescents' Thinking.
- Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin*, 108, 480-498.
- LaVoie, J. C. (1974). Cognitive determinants of resistance to deviation in seven-, nine-, and eleven-year-old children of low and high maturity of moral judgment. *Developmental Psychology*, 10(3), 393-403.
- Leman, P. J., & Duveen, G. (1999). Representations of authority and children's moral reasoning. *European Journal of Social Psychology*, 29(5-6), 557-575.
- Lin, T. J., & Anderson, R. C. (2008). Reflections on collaborative discourse, argumentation, and learning. *Contemporary Educational Psychology*, 33(3), 443-448.
- Maynard, D. W. (1985). How children start arguments. *Language in society*, 1-29.
- McKenzie, R., Evans, J., & Handley, S. J. (2010). Conditional Reasoning in Autism: Activation and Integration of Knowledge and Belief. *Developmental psychology*, 46(2), 391-403.
- Mead, G. H. (1934). *Mind, Self and Society*. Chicago: University of Chicago Press.
- Mercier, H. (in press-a) On the universality of argumentative reasoning. *Journal of Cognition and Culture*.
- Mercier, H. (in press-b) Our pigheaded core: How we became smarter to be influenced by other people. In B. Calcott, R. Joyce, & K. Sterelny (Eds.), *Evolution, Cooperation, and Complexity*. Cambridge: MIT Press.
- Mercier, H. (submitted-a). Looking for arguments.
- Mercier, H. (submitted-b). What good is moral reasoning?
- Mercier, H., & Landemore, H. (in press). Reasoning is for arguing: Understanding the successes and failures of deliberation. *Political Psychology*.
- Mercier, H., & Sperber, D. (2009). Intuitive and reflective inferences. In J. S. B. T. Evans & K. Frankish (Eds.), *In Two Minds*. New York: Oxford University Press.
- Mercier, H., & Sperber, D. (In press-a). Why do humans reason? Arguments for an argumentative theory. *Behavioral and Brain Sciences*.

- Mercier, H., & Sperber, D. (In press-b). Defending argumentation. *Behavioral and Brain Sciences*.
- Miller, S. A., & Brownell, C. A. (1975). Peers, persuasion, and Piaget: Dyadic interaction between conservers and nonconservers. *Child Development*, 992–997.
- Morsanyi, K., & Handley, S. J. (2008). How smart do you need to be to get it wrong? The role of cognitive capacity in the development of heuristic-based judgment. *Journal of Experimental Child Psychology*, 99(1), 18-36.
- Moshman, D., & Geil, M. (1998). Collaborative reasoning: Evidence for collective rationality. *Thinking and Reasoning*, 4(3), 231-248.
- Neuman, Y. (2003). Go ahead, prove that God does not exist! On high school students' ability to deal with fallacious arguments. *Learning and Instruction*, 13(4), 367-380.
- Neuman, Y., Weinstock, M. P., & Glasner, A. (2006). The effect of contextual factors on the judgement of informal reasoning fallacies. *The Quarterly Journal of Experimental Psychology*, 59(2), 411-425.
- Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomena in many guises. *Review of General Psychology*, 2, 175-220.
- Nucci, L. P. (1984). Evaluating teachers as social agents: Students' ratings of domain appropriate and domain inappropriate teacher responses to transgressions. *American Educational Research Journal*, 21(2), 367.
- Nucci, L. P. (1985). Social conflict and the development of children's moral and conventional concepts. In M. Berkowitz (Ed.), *Peer Conflict and Psychological Growth* (pp. 55-70). San Francisco: Jossey Bass.
- Nussbaum, E. M. (2008). Collaborative discourse, argumentation, and learning: Preface and literature review. *Contemporary Educational Psychology*, 33(3), 345–359.
- Orsolini, M. (1993a). " Because" in children's discourse. *Applied Psycholinguistics*, 14(1), 89–120.
- Orsolini, M. (1993b). "Dwarfs do not shoot": An analysis of children's justifications. *Cognition and Instruction*, 11(3), 281–297.
- Orsolini, M., & Pontecorvo, C. (1992). Children's talk in classroom discussions. *Cognition and instruction*, 9(2), 113–136.

- Perkins, D. N. (1985). Postprimary education has little impact on informal reasoning. *Journal of Educational Psychology, 77*, 562-571.
- Perkins, D. N., Farady, M., & Bushey, B. (1991). Everyday reasoning and the roots of intelligence. In J. Voss, D. Perkins & J. Segal (Eds.), *Informal Reasoning and Education* (pp. 83-105). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- Perlman, M., & Ross, H. S. (2005). If-then contingencies in children's sibling conflicts. *Merrill-Palmer Quarterly, 51*(1), 42-67.
- Perret-Clermont, A.-N. (1980). *Social Interaction and Cognitive Development in Children*. London: Academic Press.
- Perret-Clermont, A.-N., Carugati, F., & Oates, J. (2004). A Socio-Cognitive Perspective on Learning and Cognitive Development. In J. Oates & A. Grayson (Eds.), *Cognitive and Language Development in Children* (pp. 303-332). London: The Open University & Blackwell Publishing.
- Phelps, E., & Damon, W. (1989). Problem solving with equals: peer collaboration as a context for learning mathematics and spatial concepts. *Journal of educational psychology, 81*(4), 639-646.
- Piaget, J. (1928). *Judgment and Reasoning in the Child*. London: Routledge and Kegan Paul.
- Piaget, J. (1976). Logique génétique et sociologie. In G. Busino (Ed.), *Les Sciences sociales avec et après Jean Piaget*. Geneva Droz.
- Pontecorvo, C., & Girardet, H. (1993). Arguing and reasoning in understanding historical topics. *Cognition and Instruction, 11*(3), 365-395.
- Ram, A., & Ross, H. S. (2001). Problem solving, contention, and struggle: How siblings resolve a conflict of interests. *Child development, 17*10-1722.
- Resnick, L. B., Salmon, M., Zeitz, C. M., Wathen, S. H., & Holowchak, M. (1993). Reasoning in conversation. *Cognition and Instruction, 11*(3/4), 347-364.
- Reyna, V. F., & Brainerd, C. J. (1995). Fuzzy-trace theory: An interim synthesis. *Learning and Individual Differences, 7*(1), 1-75.
- Reyna, V. F., & Ellis, S. C. (1994). Fuzzy-trace theory and framing effects in children's risky decision making. *Psychological Science, 5*(5), 275-279.
- Reyna, V. F., & Farley, F. (2006). Risk and rationality in adolescent decision making: Implications for theory, practice, and public policy. *Psychological Science in the Public Interest, 7*(1), 1-44.

- Ritchart, R., & Perkins, D. N. (2005). Learning to think: The challenges of teaching thinking. In K. Holyoak & R. Morrison (Eds.), *The Cambridge Handbook of Thinking and Reasoning*. Cambridge Cambridge University Press.
- Ross, H., Smith, J., Spielmacher, C., & Recchia, H. (2004). Shading the truth Self-Serving Biases in Children's Reports of Sibling Conflicts. *Merrill-Palmer Quarterly*, *50*(1), 61–86.
- Scholnick, E. K., & Wing, C. S. (1991). Speaking deductively: Preschoolers' use of If in conversation and in conditional inference. *Developmental Psychology*, *27*(2), 249–258.
- Schwarz, B. B., & Glassner, A. (2003). The blind and the paralytic: Supporting argumentation in everyday and scientific issues. In J. Andriessen, M. Baker & D. Suthers (Eds.), *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning Environments*. Dordrecht: Kluwer Academic Publishers.
- Schwarz, B. B., & Linchevski, L. (2007). The role of task design and argumentation in cognitive development during peer interaction: The case of proportional reasoning. *Learning and Instruction*, *17*(5), 510–531.
- Schwarz, B. B., Neuman, Y., & Biezuner, S. (2000). Two wrongs make a right. . .if they argue together! *Cognition and Instruction*, *18*, 461–494.
- Shafir, E., Simonson, I., & Tversky, A. (1993). Reason-based choice. *Cognition*, *49*(1-2), 11-36.
- Slavin, R. E. (1995). *Cooperative Learning: Theory, Research, and Practice* (2nd ed.). London: Allyn and Bacon.
- Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary educational psychology*, *21*(1), 43–69.
- Sperber, D. (2001). An evolutionary perspective on testimony and argumentation. *Philosophical Topics*, *29*, 401-413.
- Sperber, D., Clément, F., Heintz, C., Mascaro, O., Mercier, H., Origg, G., & Wilson, D. (2010). Epistemic vigilance, *25*(4), 359-393.
- Stanovich, K. E. (2004). *The Robot's Rebellion*. Chicago: Chicago University Press.
- Stein, N. L., & Albro, E. R. (2001). The origins and nature of arguments: Studies in conflict understanding, emotion, and negotiation. *Discourse Processes*, *32*(2&3), 113-133.

- Stein, N. L., & Bernas, R. (1999). The early emergence of argumentative knowledge and skill. In J. Andriessen & P. Coirier (Eds.), *Foundations of Argumentative Text Processing* (pp. 97-116). Amsterdam: Amsterdam University Press.
- Sterelny, K. (In press). *The Evolved Apprentice*. Cambridge, MA: MIT Press.
- Sunstein, C. (2002). The law of group polarization. *Journal of Political Philosophy*, 10(2), 175-195.
- Takezawa, M., Gummerum, M., & Keller, M. (2006). A stage for the rational tail of the emotional dog: Roles of moral reasoning in group decision making. *Journal of Economic Psychology*, 27(1), 117-139.
- Tesla, C., & Dunn, J. (1992). Getting along or getting your own way: The development of young children's use of argument in conflicts with mother and sibling. *Social Development*, 1(2), 107-121.
- Tinbergen, N. (1963). On aims and methods in ethology. *Zeitschrift für Tierpsychologie*, 20, 410-433.
- Turiel, E. (1983). *The development of social knowledge: Morality and convention*. Cambridge, UK: Cambridge University Press.
- Valdesolo, P., & DeSteno, D. (2008). The duality of virtue: Deconstructing the moral hypocrite. *Journal of Experimental Social Psychology*.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.
- Webb, N. M. (1993). Collaborative group versus individual assessment in mathematics: Processes and outcomes. *Educational Assessment*, 1(2), 131-152.
- Webb, N. M. (1997). Assessing students in small collaborative groups. *Theory into Practice*, 205-213.
- Webb, N. M., Franke, M. L., Ing, M., Chan, A., De, T., Freund, D., et al. (2008). The role of teacher instructional practices in student collaboration. *Contemporary Educational Psychology*, 33(3), 360-381.
- Webb, N. M., & Palinscar, A. S. (1996). Group processes in the classroom. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 841-873). New York: Prentice Hall.
- Weinstock, M., Neuman, Y., & Tabak, I. (2004). Missing the point or missing the norms? Epistemological norms as predictors of students' ability to identify fallacious arguments. *Contemporary Educational Psychology*, 29(1), 77-94.

Willingham, D. T. (2008). Critical thinking: Why is it so hard to teach? *Arts Education Policy Review*, 109(4), 21-32.