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Reasoning serves argumentation in children

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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 argumentive 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.

> "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).

An old tension exists in philosophy and psychology between individual and social views of intelligence. In modern psychology the individual view appears to have become dominant, at least with respect to the methods used to investigate intelligence. Most often, research participants are asked to solve problems, make decisions, and make or evaluate arguments in isolation from others. Reasoning is supposed to help an individual overcome faulty intuitions (Kahneman, 2003) and solve novel

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problems (Evans & Over, 1996; Stanovich, 2004), without input 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, such as perspective taking, theory of mind and empathy (Goleman, 2006).

At least since the ancient Greeks, the possibility has been raised that intelligence and, more specifically, reasoning, are in fact a profundly social abilities (Billig, 1996). Over the last century, the most illustrious of such voices have come from developmental psychology. Baldwin (1906, p. 288) saw "no invention without some social reference". Vygotsy (1978, p. 57) stated that "every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level". And Piaget (1976, p. 80) believed that "social interaction is a necessary condition of the development of logic" (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 may be a social trait. Billig (1996) emphasizes the role of rhetoric and persuasion in social psychology. Graff (1993) insists on the importance of engaging students through teaching debates and controversies. Moral psychologists (Bloom, 2010; Haidt & Bjorklund, 2007) and philosophers (Gibbard, 1990) have pointed out the importance of argumentation and debate 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 holds 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. Section 2 onwards 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 a 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 (2009) have attempted to sharpen the distinction by defining and contrasting intuitive and reflective inferences. 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 it: the man 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 the man's behavior as the train approaches. In this case, Peter can easily state the reasons 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 point to epistemic and practical advantages of reasoning. Reasoning should help us create new beliefs, generate knowledge, and drive us toward 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 often confused by simple logical problems (Evans, 2002) and reasoning 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, we can question the idea that reasoning evolved to that end.

In contrast to the view of reasoning as a tool of individual cognition, Sperber (2001) has suggested that it may have evolved mainly for *argumentative purposes*. The evolutionary argument can only be sketched here (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. On this view, reasoning is the cognitive ability that evolved in order to help senders find reasons and receivers evaluate them. This makes reasoning a fundamentally argumentative, social device. Although the gist of the argumentative theory is that reasoning evolved mostly to serve argumentive 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 empirically. The main predictions are the following (see Mercier, submitted for publication-a, submitted for publication-b, in press-a, in press-b; Mercier & Landemore, in press; Mercier & Sperber, in press-a; Mercier & Sperber, in press-c, 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 people are engaged in discussion. There should exist 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. There is evidence that this is indeed the case (see Mercier & Sperber, in press-c, for review). When motivated to create arguments, people 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, they attain 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 toward 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 toward 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. Developmental evidence

Much evidence supports the argumentative theory of reasoning, but it is based largely on adults. 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 apply only to older individuals and result from a learning process. Clearly, one cannot conclude from adults' reading skills that reading is an evolved ability. Could the features listed above be learned? Children could learn to put their reasoning skills to use in argumentation long after these skills have developed. Reasoning could be more efficient in groups 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. In other words, the misuse of reasoning skills occurs because they were not designed to argue in the first place. It is therefore crucial to show that 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 of these features are present in children, a significant gap in the evidence supporting the argumentative theory will be filled.

Although a broad range of evidence is reviewed, the scope of the present article is limited and focused on furthering an evolutionary, or *ultimate* theory of reasoning. Tinbergen (1963) famously described four levels of analysis that can be used when investigating biological phenomena. The ultimate level bears on 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 achieve its form during development. These levels of analysis are not competitors, they are complementary (for an example of integration (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: it is 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 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 state of adult competency.

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

2. Children's argumentive skills

The first and most straightforward prediction of the argumentative theory is that people should have enough argumentive skills to be able to take part in informal arguments. Moreover, some of these skills should develop at least as early as other reasoning abilities.

In order for children to engage in informal arguments, only relatively basic argumentive skills are required. They must be able to construct and evaluate simple arguments, not build the complex and lengthy arguments in scholarly writing. They do not have to recognize argument forms or 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 predicted to be present in children may therefore leave many unsatisfied. They are certainly not sufficient to make a good essayist or debater, in the same way as speaking a language does not make one a novelist or 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 argumentive skills, from the simplest—making an argument—to the more complex—building a complex counterargument 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 argument, as it is only mastery of these skills that is predicted by the argumentative theory.

2.1. Understanding and evaluating arguments

One important source of data is the study of parenting style. Hoffman (1970a, 1970b) identifies one category of parenting techniques as those that stress the importance of reasoning, that is, of providing arguments to convince children that they should perform or not perform a given action. 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 children's part rather than critical evaluation. This 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 onto their own.

The domain in which the influence of different arguments has been the most thoroughly studied is that of moral behavior and reasoning. Based on Turiel's (1983) distinction between the moral and conventional domains, Nucci (1984) and Killen (1991) conducted a series of studies of children's conceptions of the appropriateness of arguments pertaining to these two domains. Participants, from preschoolers to adolescents, rated differently the reactions of teachers confronted with violations in the moral vs. conventional domain. Others have observed children's behavior following different injunctions to perform a moral act, such as sharing toys or candies. 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 7–10 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 (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 moral domain. On conservation tasks, second graders are much more likely to be persuaded by the arguments of a conserver than a non-conserver (Miller & Brownell, 1975). They are not simply following some sort of authority because the conservers' arguments regarding any other matters are not as likely to be

persuasive. That children are selectively swayed by good arguments is also shown by results from collaborative learning and reasoning, examined next.

Children and adolescents possess other useful argumentive skills. For example, 6-year-olds are sensitive to circular arguments (Baum, Danovitch, & Keil, 2007). High school students can 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, cannot only understand but also evaluate arguments, and that these skills continue to mature as children grow older.

2.2. Producing arguments

There is now a wealth of data on early justifications, explanations and arguments. As soon as toddlers can produce sentences, at 18–24 months of age, they use them to justify violations or to argue with parents or siblings (Kuczynski & Kochanska, 1990; Kuczynski, Kochanska, Radke-Yarrow, & Girnius-Brown, 1987; Perlman & Ross, 2005). For instance, a 3-year-old could justify her refusal to pick up her toys, stating "No. I tired," or reclaim a toy from her sibling with the justification "That's not yours" (Dunn & Munn, 1987, p. 793). By age 3, 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 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, in their abstract forms, remain difficult for many adults (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) committed (Nucci, 1985). For instance, preschoolers do not try to challenge moral rules, by, for example, saying that stealing is right generally; instead they argue that they were wronged by the victim before or that the toy was theirs all along (Brenneis & Lein, 1977; Goodwin, 1983; Maynard, 1985). Five-year-olds can also produce elaborate causal explanations as arguments (Orsolini, 1993a, 1993b; Orsolini & Pontecorvo, 1992). More felicitous or complex arguments tend to lead to successful conflict resolution. The better children are at constructing arguments, the greater the likelihood that they will successfully put an end to a conflict (Ram & Ross, 2001).

All these results may seem at odds with the message of psychologists and educators who urge more teaching of argumentive skills (Kuhn, 2005; Perkins, Farady, & Bushey, 1991). If children are naturally good at argumentation, what is left to teach? It is thus 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 uncommon before adolescence (Berkowitz & Gibbs, 1985). Moreover, as noted earlier, the basic argumentive skills that should develop mostly naturally in the course of conversations might not be appropriate for all purposes. Yet there are also reasons why children (or adults) can seem less argumentively skilled than they are.

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 argumentive 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 seek the best arguments but ones that are good enough (Mercier, submitted for publication-a). This is one of the reasons why observers are often dispirited by the level of naïve adults' arguments (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 counterarguments, 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 explanations and by asking people 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 poor performance in standard tasks is lack of compelling motivation to argue. According to the present view, reasoning is triggered by the need to convince or by evaluation of arguments for a claim deemed to be relevant. Appropriate motivation is crucial for children to deliver good arguments. Thus, Stein and Bernas (1999, p. 97) 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". All the data showing production of justifications and arguments in very young children comes from conflict resolution or negotiation situations. 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 this point of view—the situation we now turn to.

3. Collaborative learning and reasoning

3.1. Benefits of collaboration

According to the theory advanced here, reasoning should be at its best in argumentive contexts. Such contexts naturally arise when a group willing to work together disagrees —this is the kind of context for which reasoning, it has been 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 research traditions establish that collaborative reasoning and learning can provide important cognitive benefits. The first is a neo-Piagetian research program that treats socio-cognitive conflict as playing a crucial role in the development of children's reasoning abilities (Doise & Mugny, 1984; Perret-Clermont, 1980; Perret-Clermont, Carugati, & Oates, 2004). It relies substantially on the following paradigm: children must 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 factor 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 may also face an adult who tells them they were wrong and why. The most relevant finding is that the interaction very often leads to improvement at posttest, compared to a control condition in which children did not interact with a peer. This result has been observed for numerous conservation tasks or spatial transformation tasks, as early as 6 years of age (Doise & Mugny, 1984; Perret-Clermont, 1980). The benefits of collaboration for this kind of task are extremely robust (see, however, Kuhn, Pease, & Wirkala, 2009, and Wirkala & Kuhn, in press, for qualification of this conclusion).

A second tradition that demonstrates the benefits of collaborative learning comes from education research. Here data are usually gathered through long-term projects in which whole classes are compared. The learning outcomes of students who are urged to cooperate by 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 (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 in 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).

3.2. 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 argumentive account, I attempt to show that other theories fall short of explaining all the findings. Four alternatives are distinguished: (i) groups are simply one source of motivation, equivalent to other motivational factors; (ii) groups have a particular motivational power, which applies not only to reasoning, but also to other 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 argumentive mechanism—the hypothesis defended here.

3.2.1 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.

3.2.2 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 responsive 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 (Slavin, 1995; Webb, 1997). But the adverse effects of collective work mostly apply to groups facing non-intellectual 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.

3.2.3 Several scholars have suggested that humans are endowed with natural pedagogical skills (Csibra & Gergely, 2009; Sterelny, in press). It is 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 pedagogical device: a more knowledgeable individual delivers well-crafted explanations to a less knowledgeable individual whose performance depends on this understanding. However, this is the baseline that education researchers seek 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 group work, even in intellective tasks. This can happen when some students are 'free-riding' during the group work, letting the more competent students solve the task (Webb, 1993)—a situation difficult to reconcile with the notion of a natural propensity for pedagogy. In this situation, students clearly recognize the presence of more competent and less competent group members, but they still fail to generate or 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 group settings, the use of this method may 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).

3.2.4 Even if other explanations have been ruled out, the argumentative theory must account for all the aforementioned findings. In particular the latter finding—that some groups need special rewards to perform well—may seem to contradict the view adopted here. Why do all group settings not spontaneously lead to felicitous reasoning? From the present point of view, the use of artificial props is made necessary by the lack of argumentive 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 theory advanced here, 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 school topics. In line with this interpretation, one study showed 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 argumentive stake is to involve groups of participants who give different answers on 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 group discussion and in the posttest, starting in elementary school or even kindergarten (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 most advanced 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 'two wrongs make a right' that can occur with children as young as age 6 (Ames & Murray, 1982; Doise & Mugny, 1984; Glachan & Light, 1982; Schwarz, Neuman, & Biezuner, 2000).

It is interesting to note that the literature on group reasoning and decision making shows mostly positive outcomes with children while yielding many negative results for adults. In particular, adult group reasoning is often plagued by 'groupthink' (Janis, 1982) and 'group polarization' (Sunstein, 2002)—the tendencies to stifle dissenting voices and move toward more extreme opinions. Group polarization typically occurs when all group members agree to start with. They then use reasoning to find arguments supporting their 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 disagree, or, if they agree, they may not be expected to provide justifications for their answers and so do not have to argue.

I have tried to show that the theory advanced here is in a good position to explain the performance of groups so 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 argumentive theory is in a unique position to explain how the confirmation bias can be held in check by group discussion, as we will now see.

4. Reasoning biases

4.1. The confirmation bias

The confirmation bias is one of the most robust and prevalent biases observed by psychologists (Nickerson, 1998). Classical theories of reasoning tend to explain this bias as a product of our cognitive limitations. Falsification requires more cognitive skill or energy than is usually available. The classical account, however, is hard to sustain in the face of empirical evidence showing that people can be very skilled falsifiers *when they want to prove someone (or an idea) wrong* (Mercier & Sperber, in press-a). On the other hand, this pattern of results is most straightforwardly explained if reasoning is an argumentive device. When engaged in an argument, we should mostly look for arguments that support our position or rebut that of our interlocutor. From 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 an early age. Stein and Albro (2001, p. 130), reporting results from children as young as 3, 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". Likewise, Ross, Smith, Spielmacher and Recchia (2004, p. 61) 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". These siblings also "spontaneously explained . . . their negative actions" or excluded them from their reports (Ross et al., 2004, 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 Andersen (2008) point to the confirmation bias as one of the main obstacles to be overcome in science education, even though examining scientific theories is typically not 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 Lavallee (2005) 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.

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 confirmation bias. It occurs when we use reasoning not while engaged in an argument but in anticipation of 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 although they have no relation to the actual reason for which we hold our belief. Children are no less apt than adults to have recourse to rationalizations (Karmiloff-Smith, 1992, p. 81). Another consequence of motivated reasoning is that all the arguments gathered in preparation for 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, Keller, Takezawa, & Mata, 2008; Takezawa, Gummerum, & Keller, 2006). In these experiments, children (11–14-year-olds) played economic games (the ultimatum game or dictator game) in groups—for instance, deciding how many of 20 coins they would allocate to another group that had no opportunity to retaliate or reciprocate (dictator game). Stage of moral reasoning was later assessed. No correlation was observed between these stages of moral reasoning and altruistic behavior. Children at a higher stage had no propensity to give more coins. However, those who scored higher in moral reasoning were better at convincing other group members to adopt their suggestion, whether they pushed for

altruism of egoism. These results fit well both with Haidt's theory and with the present framework. This does not mean that reasoning always plays a negative role in moral development. In particular, group reasoning can sometimes lead to superior moral outcomes (Mercier, submitted for publication-b).

Aware of the pitfalls of confirmation bias, many educators have undertaken teaching of critical thinking skills, but they have only met with limited success (Ritchart & Perkins, 2005; Willingham, 2008; for a counterpoint and 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 here. However, the theory advocated here 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 minds, sometimes achieving 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 other members' arguments and change their mind if necessary, the outcome should be felicitous at 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—leads to better decisions. According to the present proposal, when reasoning is used in decision making, it performs the same function as it does in other contexts: it looks for arguments. Accordingly, reasoning should lead to decisions that are *easier to justify*—decisions for which arguments can be most easily gathered. An extensive literature on judgment and decision making supports this prediction (Mercier & Sperber, in press-a). To the extent children are less prone than adults to reasoning before making a decision, the present theory predicts that they should be less likely to fall prey to the mistakes attributed to reason-based choice. In contrast, 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, pp. 265–266, see also Reyna & Farley, 2006). At least three mistakes that are due, at least in part, to reasoning follow this pattern. One is the sunk cost fallacy—the tendency to keep investing time, energy or money into a project because an investment has already been made. Experiments show an increase with age in the percentage of children committing this fallacy (Klaczynski & Cottrell, 2004; Morsanyi & Handley, 2008). A second phenomenon of interest is 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 an experiment, children can discount irrelevant information more easily, presumably because they feel less pressure to justify themselves (Klaczynski, submitted for publication). 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).

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 taught in school are the product of careful scrutiny and likely to be 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 toward the latter and not the former, as predicted by the argumentative theory.

5. Conclusion

At least in Western society, an individualistic 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 has suffered from an important defect—its reliance on research with adults. This is problematic since, as an

evolutionary theory, the argumentative theory needs to show that the features of reasoning it predicts are not due purely to learning. 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 shows a confirmation bias from an early age (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 thereby sometimes make better decisions (Section 4.3).

Research supporting these claims would benefit from being extended in several directions. One is the study of special populations. Populations with known deficits in social cognition are of particular interest (McKenzie, Evans, & Handley, 2010). Populations with specific reasoning deficits provide another interesting comparison point (e.g., Williams syndrome).

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

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