INTRODUCTION

In this contribution, we have been tasked with the goal of discussing argumentative reasoning. Argumentative reasoning, defined as the construction and evaluation of arguments, is a general human process of which more specific forms of reasoning are a part (Oaksford, Chater, & Hahn, 2008). That argumentative reasoning lies at the heart of thinking is an idea that can be traced back to the early philosophers including Plato, Socrates, and Aristotle, who considered reasoned arguments to be the core of thinking (Kuhn, 1991).

Argumentative reasoning is, therefore, pivotal for academic success and necessary for successful functioning in a democratic society (Kuhn, 2005; Newell et al., 2011). The importance of developing argumentative reasoning is reflected in recent curricular reforms and policy initiatives in the United States, such as the Common Core State Standards (Common Core State Standards Initiative, 2010), which emphasize the importance of the ability to comprehend arguments during reading and to construct arguments during writing. Nevertheless, national US data show that only 5 percent of twelfth graders can evaluate and recognize arguments at an advanced level (National Assessment of Educational Progress, 2013), suggesting that argumentative reasoning does not develop to sufficient levels without explicit instruction.

Research on argumentative reasoning has focused on argument as a product or argumentation as a process. The term argument refers to a product, constructed in written or oral form by an individual, consisting of a claim and one or more supporting reasons or evidence that are connected to the claim with warrants (Toulmin, 2003). The term argumentation, in contrast, refers to the dynamic social process that takes place between at least two individuals, who alternate turns and seek to understand each other’s view (Kuhn, Hemberger, & Khait, 2014).

Argumentative reasoning is involved in both argument construction and argument evaluation and comprehension. In the literature, there are two quite distinct lines of research examining argumentative reasoning. One line has focused on the construction of arguments, with an emphasis on how to support the development of argumentation skills, while the other line has focused on the comprehension and evaluation of arguments in the context of reading, focusing on understanding the specific factors
that influence comprehension and evaluation, such as reader individual differences, text characteristics, and task demands.

In this chapter, we review work on argumentative reasoning from these two lines of research. In the first section, we review research on the development of argumentative reasoning from a developmental perspective. Most researchers following this perspective have studied argumentative reasoning in the context of argument construction in social and individual contexts (e.g., writing). In the second section, we discuss argumentative reasoning from a reading comprehension perspective. Most researchers following this perspective have examined comprehension and evaluation of arguments during reading. In the third section, we discuss the relationship between argumentative reasoning and epistemic cognition. In the fourth section, we discuss the potential of argumentation as a means of improving epistemic cognition. Finally, in the last section, we lay out a number of future research directions in the interest of stimulating further work in this area.

ARGUMENTATIVE REASONING FROM A DEVELOPMENTAL PERSPECTIVE

The scant evidence of research regarding the argumentative reasoning skills of young children suggests that even very young children have some competence in weighing and producing simple arguments (see Mercier, 2011, for a review). Young children are able to discern good arguments from poor ones (Eisenberg-Berg & Geisheker, 1979), they use reasons to support their arguments, and they justify their claims based on common ground assumptions, that is, assumptions that individuals take for granted (e.g., who Santa Claus is) (Köymen, Rosenbaum, & Tomasello, 2014). Mercier et al. (2014) examined the ability of preschoolers (3-, 4- and 5-year-olds) to weigh simple arguments. Their findings showed that children as young as 3 years old preferred an argument from perception to a circular argument, implying the existence of basic skills of argument evaluation even in 3-year-olds. However, older children exhibited more consistency in their preference for the argument from perception, suggesting that there is a developmental progression in argument evaluation performance. In addition, Anderson et al. (1997) examined the properties of fourth graders’ naturally occurring arguments and concluded that young children show some competence in producing simple arguments with logical syntax. These basic, simple argumentative skills of producing simple arguments, exhibited by young children, are not sufficient, though, for the citizens of the twenty-first century (Mercier, 2011). Skilled argumentation involves more complex argumentative skills, namely the ability to produce counterarguments and rebuttals. Walton (1989) identified skilled argumentation as the ability to address and undermine the opponent’s position by identifying and challenging weaknesses in his or her argument, as well as securing commitments from the opponent that can be used to support one’s own argument.

Research suggests that children and even adults exhibit serious weaknesses in argumentation in terms of Walton’s (1989) criteria (Iordanou & Constantinou, 2014; Jiménez-Aleixandre, Rodríguez, & Duschl, 2000; National Assessment of Educational Progress, 2013). That is, individuals focus on exposition of their own position to the neglect of attending to their opponent’s claims, and attempting to weaken the force of opposing claims through counterarguments. Also, individuals fail to use evidence to support their arguments and counterarguments consistently. As a result, many
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researchers have attempted to support the development of argument skills either by
direct instruction or through offering opportunities for extensive practice in a social
context. One line of research, focusing particularly on the development of written
arguments, has employed approaches to improving the production of arguments by
drawing on argument schemas and writing-specific skills. These approaches include
explaining what constitutes a good argument to the student (Nussbaum & Schraw,
2007); providing examples (Nussbaum, 2008); providing hints and models of argu-
ments from experts (Bell & Linn, 2000); teaching strategies that help produce good
written arguments (De La Paz & Graham, 1997; Graham & Harris, 1989); teaching stu-
dents to organize the structure and order of presenting arguments, as well as including
both pro and contra arguments in their essays (Butler & Britt, 2011); training students
to use outlines (Erkens, Jaspers, Prangsma, & Kanselaar, 2005), graphic visualizations
(Lu & Zhang, 2013; Nussbaum & Schraw, 2007), and interactive dialogical computer
programs (Larson, Britt, & Kurby, 2009); and assigning students goals to focus on both
sides of an argument (Page-Voth & Graham, 1999; Wolfe & Britt, 2008), content, and
audience (Midgette, Haria, & MacArthur, 2008). The efficacy of the aforementioned
interventions has been to some extent established with respect to proximal outcome
measures (Andrews, Torgerson, Low, & McGuinn, 2009), but transfer to distal outcome
measures has been relatively limited (Nussbaum, 2008).

Another line of research has focused on supporting the development of argumenta-
tive reasoning through argumentative, collaborative dialogues that take place in a social
context. In this approach, dialogic argumentation is viewed as a productive vehicle for
developing both individual and dialogic argumentative competencies. The develop-
ment and implementation of several curriculums involving dialogic argumentation
between peers showed that collaborative dialogic argumentation supports the devel-
opment of argumentative reasoning skills (Anderson, Chinn, Chang, Waggoner, & Yi,
1997; Berland & Reiser, 2011; Kuhn et al., 2014; Schwarz & De Groot, 2007). A series of
studies has shown that a curriculum based on extensive engagement in dialogues with
peers who hold an opposing position on a socio-scientific topic and reflective activities
supported the development of students’ argumentation skills (Crowell & Kuhn, 2014;
Iordanou, 2010; 2013; Iordanou & Constantinou, 2014, 2015; Kuhn, Goh, Iordanou, &
Shaenfield, 2008; Kuhn, Zillmer, Crowell, & Zavala, 2013). Specifically, dense engage-
ment in argumentation over an extended period of time proved to be a facilitative con-
dition for supporting participants’ ability to produce two-sided rather than one-sided
arguments (Crowell & Kuhn, 2014; Iordanou, 2010) and to employ evidence to justify

Besides improvements in individuals’ argumentation skills obtained in the context of
the aforementioned instructional approaches or interventions, there is also evidence of
transfer. Specifically, the gains observed in collaborative computer-based argumentation
skills transferred from the social to the individual plane, as evidenced by improvements
in individuals’ written argumentation (Kuhn et al., 2013; Kuhn, Goh et al., 2008), and
across communication modes, as shown by improvements in individuals’ face-to-face
argumentation (Iordanou, 2013). In addition, transfer has been observed across topics
within a particular domain (Crowell & Kuhn, 2014; Kuhn, Goh et al., 2008) and across
knowledge domains. Specifically, Iordanou (2010) examined transfer across domains
by having sixth graders engage in a collaborative argumentative curriculum on either
a science or a social topic, while a third group of sixth graders served as a control.
Findings showed that participants, besides exhibiting improvements in their argumenta-
tion skills in their intervention topic, transferred these improvements across both
domains. However, a difference in the magnitude of transfer was observed. The science condition led to a larger increase in the levels of counterargument on the science topic, while the social and science conditions were equally effective in increasing levels of these strategies on the social topic. This finding may be due, in part, to the potential influence of meta-level strategic understanding (i.e. understanding of the goals of an argument) (Kuhn, Goh et al., 2008; Iordanou & Constantinou, 2014) and epistemic understanding, which we discuss in the “Argumentative Reasoning and Epistemic Cognition” section later in the chapter (Iordanou & Constantinou, 2015; Kuhn et al., 2013; Ryu & Sandoval, 2012).

Evidence for development of meta-level understanding, along with development in argumentation strategies, comes from research that examined meta-talk, which is the talk participants engage in about the discourse itself. Specifically, an examination of participants’ meta-talk using the microgenetic method, which involved a close examination of participants’ argumentative reasoning during extended practice in argumentation, showed that participants developed a meta-level understanding of argumentative strategies (Kuhn, Goh et al., 2008; Kuhn et al., 2013) and of the role of evidence in argumentation (Iordanou & Constantinou, 2014, 2015). These findings suggest that meta-level understanding of argumentation also develops through sustained engagement in argumentation in the social context, and supports the development of argumentative reasoning skills.

In summary, research on the development of argumentative reasoning has focused primarily on the construction of arguments. Different approaches have been employed for supporting the development of argument skills including direct instruction, scaffolding, and extensive practice in argumentative dialogues in the social context. Taken together, the findings have shown that argumentation skills can be successfully developed when they receive specific attention. The findings regarding transfer across communication modes, topics, and domains suggest that argumentation skills are both domain general and domain specific. In addition, besides improvements at the procedural level, improvements have also been observed at the meta-level, suggesting that argumentative reasoning is multifaceted (Kuhn et al., 2013; Duschl, 2008). As we mentioned previously, the focus of this work has been primarily on the construction of arguments, rather than comprehension of arguments. We turn to this issue next.

ARGUMENTATIVE REASONING FROM A READING COMPREHENSION PERSPECTIVE

Comprehension and evaluation of arguments often take place in the context of reading texts. Thus, reading comprehension processes themselves also directly influence the development of argument skills. Reading comprehension involves the complex interactions between reader individual differences, the demands of the task, and the characteristics of the text (Snow, 2002). Even though there are many definitions of what actually constitutes successful reading comprehension, a core component of most definitions is that it involves the construction of a mental representation of the text in readers’ memory (McNamara & Magliano, 2009). This mental representation is the product of reading, what is often called the situation model (van Dijk & Kintsch, 1983). Independent of the unit of analysis or grain size, the widely adopted view is that situation models are represented in the form of interconnected networks of information or semantic networks (Collins & Quillian, 1969). These networks represent information in
the text and prior knowledge as a system of interconnections in memory. The networks are typically represented as diagrams of nodes (e.g. concepts, idea units) and links (i.e. relations) often depicting complex relations.

Thus, it is reasonable to assume that comprehension of arguments in the context of reading critically depends on the construction of a situation model during reading, and that the coherence and interconnectedness of the situation model will reflect the extent to which an argument has been successfully understood. It also follows that factors known to influence the construction of situation models will also influence the comprehension of arguments. These factors include reader individual differences, such as prior knowledge and beliefs; text characteristics, such as text structure and text cohesion; and task demands, such as reading goals.

Indeed, research has highlighted several reader individual differences that influence comprehension of arguments, including the extent to which readers hold knowledge related to the issue (Nussbaum & Kardash, 2005; Nussbaum & Schraw, 2007; Rouet, Britt, Mason, & Perfetti, 1996), beliefs and attitudes related to the issue (Wolfe, Britt, & Butler, 2009; Wolfe, Tanner, & Taylor, 2013), and interest (Golanics & Nussbaum, 2008). This research has also highlighted a specific aspect of prior knowledge that is critically important for the comprehension of arguments, the argumentation schema (Nussbaum & Schraw, 2007; Piolat, Roussey, & Gombert, 1999; Wolfe et al., 2009). The argumentation schema includes a set of expectations about the structure, content, and purpose of argumentative texts. There is strong evidence that during reading, claims activate the argumentation schema in readers’ memory, and that this schema facilitates the comprehension of arguments (Britt & Larson, 2003) by also activating knowledge, attitudes, and beliefs related to the theme (Wolfe, 2012).

Research also has highlighted several text characteristics that influence comprehension of arguments during reading, including argument and text structure. With respect to argument structure, claim–reason arguments are comprehended faster and better than reason–claim arguments (Britt & Larson, 2003), presumably because claims activate the argumentation schema more so than reasons (Wolfe et al., 2009). With respect to text structure, texts that include arguments and counterarguments (i.e. two-sided texts) are perceived as more credible and persuasive (O’Keefe, 1999) than texts containing only a single argument (i.e. one-sided texts). This research examined the effects of text structure on argumentation in argumentative, persuasive, and refutation texts. Argumentative texts aim to advance a position (Wolfe, 2012), and as such, they are often two-sided, including arguments and counterarguments. They emphasize evidence-based argumentation, rather than persuasion, thus the author assumes a relatively neutral stance (Buehl, Alexander, Murphy, & Sperl, 2001), and it is left to the reader to evaluate both sides. Persuasive texts aim to change attitudes or beliefs, often about controversial issues, by supporting a single viewpoint (Petty & Cacioppo, 1986), and as such they are either one-sided or two-sided (Murphy, 2001, 2007; Murphy & Alexander, 2004, 2008). One-sided persuasion texts exclude other-side arguments, and even though they align nicely with the “myside bias” phenomenon observed in the production of arguments for both children and adults (Kuhn, 1991; Sandoval & Millwood, 2005), they are less effective in persuading readers than two-sided persuasion texts (Wolfe et al., 2009). In the case of two-sided persuasion texts, which include other-side and my-side arguments, the balance is clearly in favor of the author’s side, who assumes a clear my-side stance. The effectiveness of two-sided persuasion texts depends on the complex interactions between many factors above and beyond the text itself, including the nature, value, and strength of readers’ beliefs.
(Chambliss & Garner, 1996), as well as motivated reasoning (Dole & Sinatra, 1998; Gregoire, 2003; Murphy & Alexander, this volume; Sinatra, Kienhues, & Hofer, 2014).

Refutation texts aim to change knowledge, often what is termed misconceived or incorrect knowledge (Hynd, 2001), and as such they are often two-sided. Refutation texts combine characteristics from argumentative and persuasive texts. Like argumentative texts, they emphasize evidence-based argumentation. Like persuasion texts, the balance is clearly on the author’s side, who assumes a clear my-side stance. A unique component of refutations texts is that “my-side” corresponds to normative knowledge that is clearly specified, whereas the other side corresponds to incorrect knowledge that is misconceived or ill-specified. The effectiveness of refutation texts depends almost exclusively on the causal explanations that support the normative knowledge, and specifically on the interconnectedness of the explanation (Kendeou & O’Brien, 2014; Kendeou, Smith, & O’Brien, 2013; Kendeou, Walsh, Smith, & O’Brien, 2014).

Further, research also has highlighted that task demands, such as specific goals during reading, influence the comprehension of arguments and the extent to which readers integrate arguments from different documents or sources (Anmarkrud, Bråten, & Strømsø, 2014). Specifically, goals to read and construct arguments promote comprehension of arguments more than goals to summarize or explain (Wiley & Voss, 1996, 1999). Further, tasks that require comprehension of conflicting viewpoints result in integration that is organized around an argument schema (Britt & Rouet, 2012). In this context, integrative processes such as evaluation and monitoring of different viewpoints strongly relate to argumentative reasoning.

Gaining a better understanding of comprehension and evaluation of arguments in the context of reading comprehension is important because it can help to identify the source of argumentative reasoning failures that pertain to reading comprehension itself. For example, high school and college students often show deficiencies in evaluating arguments, and specifically in identifying flawed arguments in the texts they read (Wolfe et al., 2009). These limitations may be due in part to failures to activate all constituent parts of an argument, namely the argument schema (Kurby, Britt, & Dandotkar, 2006; Wolfe et al., 2009); failures to accurately represent the arguments in memory, namely constructing a situation model; or, failures to retrieve the arguments from memory (Britt, Kurby, Dandotkar, & Wolfe, 2008). Identifying the specific source of the failure is important for the design of interventions or instructional approaches to improve argumentative reasoning during reading. Indeed, training studies designed to improve comprehension of arguments have highlighted the benefits of training on specific factors that are known to influence reading comprehension, such as providing elaborate and specific goals for reading (Wiley & Voss, 1996, 1999), activating argumentation schemas (Lin, Horng, & Anderson, 2014), and using computer tutorials to scaffold comprehension (Larson, Britt, & Kurby, 2004).

It is important to note that comprehension and evaluation of arguments has been examined in other literatures as well, including persuasion in social psychology (Petty & Cacioppo, 1981), conceptual change in science education (Dole & Sinatra, 1998), and reasoning fallacies in logic (Hahn & Oaksford, 2006). Work in these areas has shown that individuals have the capacity to produce and evaluate arguments, especially when they engage in group discussions (Mercier, 2011). Furthermore, work on reasoning skills in different fields (Mercier & Sperber, 2011) has highlighted what has also been documented in the reading comprehension literature, namely that successful comprehension and evaluation of arguments depends on the interactions between individual differences, message characteristics, and task or context demands.
ARGUMENTATIVE REASONING AND EPISTEMIC COGNITION

Beyond the general skills that are entailed in the construction and evaluation of arguments discussed in the previous sections, argumentative reasoning also encompasses meta-level dimensions. Besides the meta-strategic understanding that we have already discussed (Kuhn, Goh et al., 2008; Iordanou & Constantinou, 2014), argumentative reasoning is supported by epistemic cognition. Individuals’ beliefs about knowledge and how it is constructed are likely to influence their engagement with knowledge (Sandoval, 2005). To differentiate knowledge and beliefs about the nature of knowledge and knowing from the acquisition of knowledge, Kuhn (2001) proposed the term meta-level knowledge, while Barzilai and Zohar (2014) suggested the term epistemic metacognitive knowledge. The latter term is further differentiated into epistemic metacognitive knowledge about persons (i.e. knowledge about the individual as knower, about other people as knowers, and about human knowledge in general), and about strategies and tasks (i.e. knowledge about how to pursue an activity that will result in knowing). The relation between argumentation and epistemic cognition has been described explicitly in Kuhn’s (2001) and Chinn et al.’s (2011) models. In Kuhn’s (2001) model, epistemic understanding is conceptualized as a fundamental meta-level foundation that supports argumentative reasoning. In her theoretical framework about intellectual performance, she identified two kinds of meta-level knowing that support the execution of argumentation. The first is procedural meta-knowing, which refers to meta-task and meta-strategic understanding, as well as to management of the task and the strategies one has available to use. The second meta-level knowing is declarative meta-knowing, which refers to one’s epistemic understanding regarding knowledge and knowing. This declarative or epistemic meta-knowing determines whether known strategies are executed. Epistemic meta-knowing informs intellectual values, which deal with questions such as “Is there a point to arguing?” and determines which strategies are applied. In Kuhn’s model, the developmental task that underlies the progression towards mature epistemic understanding is the coordination of the subjective and objective dimensions of knowing (Kuhn, Cheney, & Weinstock, 2000). In this context, epistemic understanding progresses from the absolutist level, where the objective dimension of knowing dominates and knowledge is conceived as an objective, external entity, which is knowable with certainty, to the multiplist level where the uncertain and subjective nature of knowledge dominates, and then to the evaluativist level where a balance is achieved between the objective and subjective dimensions of knowledge.

Chinn et al. (2011) proposed a model of epistemic cognition that involves five interconnected components. These components are (a) epistemic aims and epistemic values; (b) the structure of knowledge and other epistemic achievements; (c) the sources and justification of knowledge and other epistemic achievements, together with related epistemic stances; (d) epistemic virtues and vices; and (e) reliable and unreliable processes for achieving epistemic aims. Argumentation is one type of reliable process (i.e. processes by which knowledge is achieved), along with perception and testimony, for achieving epistemic aims (i.e. goals related to finding things out, understanding them, and forming beliefs). Chinn and his colleagues suggested that individuals’ beliefs about the conditions under which argumentation is considered a reliable process predict and explain individuals’ learning processes as well as the outcomes of the learning processes on particular tasks.

Several studies have investigated the influence of epistemic cognition on argumentation, and even though they have varied with respect to which epistemic
cognition framework they depended on, the findings have been remarkably consistent. Overall, this work suggests that more sophisticated epistemic beliefs relate to better argumentative reasoning skills (Weinstock, 2005, 2011; Weinstock & Cronin, 2003). Specifically, epistemic beliefs influence the reading strategies enacted (Kardash & Howell, 2000), overall comprehension of argumentative (Mason & Boscolo, 2004) and refutation (Kendeou, Muis, & Fulton, 2011) texts, as well as the conclusions drawn from such texts (Kardash & Scholes, 1996; Schommer, 1990). Also, there is strong evidence that mature epistemic beliefs are associated with better understanding of the purpose and value of argumentative discourse in enhancing understanding (Kuhn, Wang, & Li, 2010). Further, epistemic beliefs predict the extent to which readers will detect argumentation reasoning fallacies, such as “ad ignorantiam,” what is known as the argument from ignorance fallacy (Weinstock, Neuman, & Glassner, 2006). Finally, epistemic beliefs predict engagement in meta-level processing while reading a text (Iordanou et al., submitted).

Besides the relation between epistemic beliefs and evaluation of arguments, a relation between epistemic beliefs and argumentation skills has also been observed. In particular, Mason and Scirica (2006) found that epistemic understanding was a significant predictor of the production of an argument, counterargument, and rebuttal after reading a text on a controversial topic. Participants with evaluativist epistemic understanding, who appreciated both the subjective and objective dimensions of knowledge, generated arguments, counterarguments, and rebuttals of a higher quality than participants with multiplist epistemic understanding, who over-emphasized the uncertain and subjective dimension of knowledge. Nussbaum et al. (2008) also found differences in argumentative reasoning between students with different epistemic understandings. Specifically, students with evaluativist epistemic understanding tended to disagree with their interlocutor, cite contradictory facts, and point out the need for more information in argumentation, while students with multiplist epistemic understanding interacted less with their interlocutors and were less critical of arguments offered by their discussion partner. Further, there is evidence for the relation between certain dimensions of epistemic cognition and argumentation, such as (a) justification of knowledge, which predicts the quality of written argumentative texts (Bråten, Anmarkrud, Brandmo, & Strømsø, 2014; Bråten, Ferguson, Strømsø, & Anmarkrud, 2013; Ferguson & Bråten, 2013; Mason & Scirica, 2006; Nussbaum, Sinatra, & Poliquin, 2008), and (b) certainty of knowledge, which negatively predicts resolving global ambiguities (Kardash & Howell, 2000) and willingness to engage in argumentation (Bell & Linn, 2000; Nussbaum & Bendixen, 2003).

**IMPROVING EPISTEMIC COGNITION VIA ARGUMENTATION**

The research we have reviewed thus far suggests that there is an intimate relationship between epistemic understanding and argumentative reasoning. Both skilled evaluation and production of arguments are related to advanced epistemic understanding. Thus, the question of how researchers and educators can support the development of epistemic understanding is a central one for argumentative reasoning. The position that we propose here is that epistemic understanding develops in sync with argumentative reasoning. We further suggest that the context of dialogic argumentation that proved to be a productive condition for developing argumentative reasoning, even for very young children, can also be a promising vehicle for developing epistemic understanding.
Iordanou and Constantinou’s (2015) work offered some suggestive data regarding the facilitative role of dialogic argumentation in promoting epistemic understanding. In this study, eleventh graders engaged in collaborative dialogic argumentation, in the context of the SOCRATES web-based learning environment, on the topic of climate change. The SOCRATES learning environment included a knowledge base on the topic of climate change, a chat tool that was used for conducting argumentation, and reflective templates where students were asked to construct evidence-based arguments and reflect on the arguments they produced while they were engaging in dialogic argumentation. Students working with a partner engaged in electronic argumentative dialogues with classmates who held an opposing view on the topic, and in evidence-focused reflective activities based on transcriptions of their dialogues. The findings showed an increase in the use of scientific data to support students’ arguments, a decrease in the use of personal opinions, and an increase in citation of the source of the data used. These findings suggest that students developed, at least implicitly, an advanced epistemic understanding. Students exhibited a shift from presenting their “correct,” self-evident theories without providing any data to support their arguments, to employing data to support their positions and offering alternative interpretations for a particular piece of evidence. Kuhn et al. (2013) also reported gains in epistemic understanding for students who engaged in prolonged dialogic argumentation. In particular, they observed gains in epistemic understanding of the norms that govern argumentation in terms of what constitutes acceptable claims of knowledge and acceptable forms in which to advance them in discourse.

Consistent with these findings, Ryu and Sandoval (2012) also obtained evidence for children’s understanding and application of epistemic criteria (i.e. criteria regarding the production of coherent claims and the explicit justification of such claims with appropriate evidence) of scientific arguments as a result of instruction focusing on argumentation. In this study, children’s appropriation of four epistemic criteria were examined: (a) causal structure, (b) causal coherence, (c) citation of evidence, and (d) employment of warrants for proposed relations between claims and data. The findings showed that children improved in their ability to both construct and evaluate arguments, especially in the ways children met evidentiary criteria.

Iordanou (2010) directly assessed participants’ epistemic understanding before and after their engagement in an argumentative-based intervention. Findings showed that engagement in the argumentative intervention supported participants’ development of a more evaluativist epistemic understanding. The improvement observed in epistemic understanding was domain specific. This finding is consistent with the view that there are qualitatively different challenges in the development of epistemic understanding across domains (Kuhn, Iordanou, Pease, & Wirkala, 2008). Specifically, the major challenge in the social domain is to overcome the view that human interpretation plays an unmanageable, overpowering role, whereas the major challenge in the science domain is to recognize that human interpretation plays any role at all.

In summary, there are some preliminary findings, from observational and experimental studies, showing that sustained engagement in argumentation supports the development of some aspects of epistemic cognition. Yet, given the complexity of epistemic cognition, there is a need for further research in this area. We discuss specific ideas for future research next.
IMPLICATIONS AND FUTURE DIRECTIONS

As we mentioned above, argumentative reasoning has been researched in different fields and with very different lenses and approaches. One line of research has focused on the construction of arguments, and how to support the development of argument skills, while another line has focused on the comprehension and evaluation of arguments in the context of reading. We believe that building bridges between these two lines is important for acquiring a more comprehensive understanding of argumentative reasoning. A related issue pertains to the much-needed cross talk among these different areas and the establishment of a common language to facilitate better communication and collaboration.

The distinction in the literature between argument construction on the one hand, and argument evaluation and comprehension on the other hand, does not necessarily imply that different skills are involved for construction versus comprehension of arguments. The evidence of transfer of gains in argument skills, for example from dialogic argumentation to evaluation of arguments at the individual level (Kuhn et al., 2013; Ryu & Sandoval, 2012), suggests that there is a core set of skills that supports both argument construction and evaluation. More work is needed to identify this core set of skills and provide insights regarding whether, and if so to what degree, argumentative reasoning is task specific.

Another question that is still open is the issue of domain-specificity versus domain-generality of argument skills. The evidence of transfer of argument skills across modes, topics, and domains suggests the generality of these skills. Yet, evidence for asymmetric transfer of argument skills across domains (Iordanou, 2010) suggests that there are also domain-specific components in argumentative reasoning. To address this issue we think it is important to approach argumentative reasoning as a multifaceted construct (Kuhn et al., 2013; Duschl, 2008). Besides cognitive skills, argumentative reasoning also involves meta-strategic understanding and understanding of the epistemic norms of argumentation (Iordanou & Constantinou, 2014, 2015; Kuhn, Goh et al., 2008; Ryu & Sandoval, 2012). The findings of Kuhn, Iordanou et al., (2008) suggesting that there are specific epistemic challenges that need to be addressed for developing epistemic understanding in a particular domain offer at least a partial explanation of the asymmetric transfer observed in argumentation skills across domains. What constitutes evidence in one domain differs from what is considered evidence in another domain. Development of the epistemic norms of argumentation in a particular domain might be required for skilled argumentation in a particular domain. Further research is required to illuminate the field’s understanding of how epistemic cognition influences argumentative reasoning.

Another question that remains open is whether an intervention that promotes the development of epistemic cognition would also support the development of argumentative reasoning. Studies that examined the reverse relationship, that is, the effect of interventions that promote argumentative reasoning on epistemic cognition, yielded some promising findings. First, these studies (Iordanou & Constantinou, 2015; Kuhn et al., 2013) showed that argumentation is a prominent arena for studying and understanding individuals’ epistemic beliefs. Specifically, dialogic argumentation offers a window to students’ epistemic beliefs and to what Chinn and colleagues (2011) refer to as students’ epistemic aims and values. Thus, studying students engaged in dialogic argumentation over time could be a promising way to respond to the call by Sandoval (2014) for more research employing the microgenetic method in order...
to develop a comprehensive understanding of epistemic development (Iordanou & Constantinou, 2015). Second, the findings of the studies that involved argumentative, collaborative dialogues suggest that argumentation might be a promising vehicle for supporting the development of epistemic understanding. Given the complexity of epistemic cognition, future research needs to examine how argumentation influences the development of different components of epistemic cognition, such as epistemic values and justification of knowledge (Greene, Muis, & Pieschl, 2010), and how domain or task specific this development is.

CONCLUDING REMARKS

To conclude, our review of the literature on argumentative reasoning, including both construction and comprehension of arguments, and epistemic cognition, suggests that argumentative reasoning and epistemic cognition are closely intertwined. In this chapter, we have highlighted evidence showing that engagement in dialogic argumentation appears to be a promising vehicle for supporting both argumentative reasoning and epistemic cognition. We suggest that further research is required to provide insights regarding the development of epistemic cognition and its interconnection with argumentative reasoning.

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