The Inferential Language Comprehension (*iLC*) Framework: Supporting Children's Comprehension of Visual Narratives

Panayiota Kendeou, Kristen L. McMaster, Reese Butterfuss, Jasmine Kim, Britta Bresina & Kyle Wagner

Department of Educational Psychology

University of Minnesota

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Correspondence: Dr. Panayiota Kendeou, Department of Educational Psychology, University of Minnesota, 56 East River Road, Minneapolis, MN 55455; E-mail: kend0040@umn.edu

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Abstract

We present an integrated theoretical framework guiding the use of visual narratives in educational settings. We focus specifically on the use of static and dynamic visual narratives to teach and assess inference skills in young children and discuss evidence to support the efficacy of this approach. In doing so, first we review the basis of the integrated framework, which builds on major findings of cognitive, developmental, and language research highlighting that (a) inference skills can be developed in non-reading contexts using different media, (b) inference skills can transfer across different media, and (c) inference skills can be improved using questioning that includes scaffolding and specific feedback. Second, we review instructional and assessment approaches that align with the proposed framework; these approaches are designed to teach or assess inference making skills using visual narratives and interactive questioning. In this context, we discuss how these approaches leverage the unique affordances of static and dynamic visual narratives with respect to unit of meaning (by increasing opportunities to generate inferences), multimodality (by providing opportunities to generate inferences of higher complexity than text), and vocabulary/knowledge demands (by providing vocabulary/knowledge support), while also reviewing evidence for their usability, feasibility, and efficacy to improve educational outcomes. We conclude with important theoretical and practical questions about future work in this area.

The Inferential Language Comprehension (*iLC*) Framework: Supporting Children's Comprehension of Visual Narratives

In this theoretical contribution, we present *the Inferential Language Comprehension (iLC) Framework*, a theoretical framework we developed to guide the use of visual narratives in educational settings. We focus specifically on the use of static and dynamic visual narratives to teach and assess inference skills in young children and discuss evidence to support the efficacy of this approach. The ultimate goal is to use this framework in developing evidence-based approaches that improve reading comprehension by enabling direct instruction of comprehension skills concurrently with, as opposed to following, decoding skills. For this reason, it is important to articulate at the outset our view of reading comprehension and how it relates to *iLC***.**

Reading comprehension is multidimensional and depends on the execution and integration of many cognitive processes (Kendeou & Trevors, 2012; van den Broek & Espin, 2012; van den Broek, Rapp, & Kendeou, 2005). We adopt a 'cognitive view' of reading comprehension (Kendeou, McMaster, & Christ, 2016; Kendeou, van den Broek, Helder, & Karlsson, 2014; McMaster, Espin, & van den Broek, 2014), which aligns with the Construction-Integration model (Kintsch & van Dijk, 1978) and posits that to understand a text, the reader needs to use background knowledge to process and connect individual words and sentences, resulting in the construction of a coherent mental representation or model of what the text is about (i.e., a situation model). Most models of reading comprehension include some variation of these processes and identify two important components: decoding and language comprehension (as articulated by the Simple View of Reading; Gough & Tunmer, 1986). Decoding includes skills needed to decipher written code such as phonological awareness, orthographic processing, and word recognition. Language comprehension includes skills needed to build a coherent mental representation, such as inference making. This mental representation or mental model includes textual information and background knowledge connected via semantic relations (e.g., causal relations). Such semantic relations can be identified by the reader through inferential processes (Kintsch, 1988; van den Broek et al., 2005). Thus, *inference making* is a fundamental skill that enables the construction of coherent representations during reading comprehension.

The Inferential Language Comprehension (iLC) Framework

The Inferential Language Comprehension (iLC) Framework posits that language comprehension depends on a *general inference skill* that can transfer across contexts and media. Drawing an inference is conceptualized as a two-stage process that involves the activation and integration of information (Oakhill, 1984). It follows that asking questions can prompt inferences because they 'cue' activation of relevant information, and facilitate integration of that information to answer the question (Graesser & Franklin, 1990). Figure 1 illustrates this general inference process: in the context of different media (e.g., text, static, or dynamic visual narratives), information needed for comprehension is activated by questioning, and further integrated through scaffolding and feedback. Integration facilitates inferences that help build a coherent mental model of the narrative. Specifically, if questioning successfully activates information needed to draw an inference and that information gets integrated, then drawing the inference is successful and is validated by explanatory feedback. If drawing an inference is not successful, either because of failures to activate or integrate the information needed, then explanatory feedback is provided along with scaffolding designed to facilitate activation and integration of the needed information. As we describe next, this framework is used to personalize inference training for young students by leveraging the affordances of static and dynamic visual narratives. In what follows, we review relevant literature to provide evidence for each of the core principles of the framework.

-------------------Insert Figure 1 about here------------------

Inference processes are critical for comprehension. An inference is information that is retrieved or generated to *fill in* information that is left implicit during comprehension (Kintsch, 1998; McNamara & Magliano, 2009; Oakhill, 1984). The process of generating an inference is two-staged. At the first stage, current information in the text activates into working memory previously acquired information (from prior text or long-term memory). At the second stage, the current information gets integrated with the previously acquired information. Activation and integration are asynchronous, parallel processes with the onset of activation preceding the onset of integration (O'Brien & Cook, 2016). Thus, activation is independent of integration and cannot guarantee integration (Blanc, Kendeou, van den Broek, & Brouillet, 2008; Kendeou, Smith, & O'Brien, 2013; Long & Chong, 2001).

The activation and integration of information are conceptualized as passive processes that have potential to be influenced by attentional, strategic processes. Indeed, the execution of these two processes is influenced by the comprehender's standards of coherence. Standards of coherence refer to a set of implicit or explicit criteria for comprehension that individuals employ (van den Broek, Bohn-Gettler, Kendeou, Carlson & White, 2011). These criteria vary between individuals, as well as within an individual across comprehension situations. These standards are influenced directly by characteristics of the reader, the text, the context, and the reading task (Snow, 2002).

Understanding the dynamic and interactive nature of activation and integration processes can contribute to a deeper understanding of the relevant individual differences, task demands, and text characteristics that can influence inference generation. It also follows that potential sources of failure in inference generation may be closely tied to whether there is activation and/or integration of relevant information. As mentioned above, the mere activation of relevant information is not sufficient to ensure integration. In fact, there is evidence that even when readers have information available, they differ in the extent to which they integrate that information to generate an inference (Cain, Oakhill, Barnes, & Bryant, 2001). Furthermore, difficulties in the activation stage may be due to lack of knowledge, lack of knowledge accessibility, or working memory limitations (Daneman & Carpenter, 1980; Engle & Conway, 1998). Such difficulties may prohibit inference generation because failing to reactivate relevant information precludes integration.

Inference making is a general skill. Kendeou (2015) reviewed evidence from the developmental literature to demonstrate that inference generation is a general skill that develops early in a child's life. For example, infants make inferences about what they see and what they hear, the locations of different objects, and people's emotions from facial expressions; 2-year-old children infer relations between sequences of events (Bauer, 2007; Bauer & Lukowski, 2010); 4- and 6-year-old children infer antecedents and consequences of actions in various settings and contexts (Lynch & van den Broek, 2007; van den Broek, Lorch, & Thurlow, 1996), including aurally presented stories (Trabasso & Nickels, 1992); 7- and 8–year old children begin to understand the dynamic interrelationships between sequences of pictures (Bornens, 1990). Thus, even very young children engage in inferential processes to comprehend the events they experience in their everyday lives.

The general inference view is further supported by evidence for the positive transfer of inference skills across different media (Kendeou, Bohn-Gettler, White, & van den Broek, 2008).

First, understanding texts presented using different media (visually, aurally, written) involves the construction of a coherent representation of the information being presented. Constructing this representation requires many of the same cognitive processes (Cohn, 2018; Gernsbacher, 1990; Kintsch, 1998; Kim, 2016; Magliano, Loschky, Clinton, & Larson, 2013; Magliano, Radvansky, & Copeland, 2007). Specifically, when processing events conveyed in a static or dynamic visual narrative, viewers need to engage in the same mapping processes that are essential to text comprehension to comprehend the sequence of images in a series of panels or shots. These mapping processes are akin to the kinds of inferences (e.g., bridging) that readers generate during reading (McNamara & Magliano, 2009). Indeed, Magliano et al. (2013) identified inferences as one of the key 'back-end' processes that supports the construction of a mental model across media. Second, the same structural factors (e.g., number of causal connections, explicitness of goals, event boundaries) predict what individuals remember from text and visual (static and dynamic) narratives (Lorch & Sanchez, 1997; Magliano, Kopp, McNerney, Radvansky, & Zacks, 2012; van den Broek, Helder, & Van Leijenhorst, 2013). Finally, several other shared processes across media can facilitate transfer, such as semantic processing and event segmentation (Cohn & Bender, 2017; Magliano et al., 2013; Magliano, Larson, Higgs, & Loschky, 2016; Zacks, Speer, & Reynolds, 2009).

It is important to note that the general inference view (Kendeou et al., 2008; Kendeou, van den Broek, White, & Lynch, 2009; Magliano, et al., 1996, 2012, 2013; van den Broek et al., 1996, 2013) does not preclude media-specific influences on inference generation (Pezdek, Lehrer, & Simon, 1984). These influences are the result of 'front-end' processes, namely processes of information extraction and attentional selection, which vary significantly across media (Loschky, Hutson, Smith, Smith, & Magliano, 2018; Loschky, Larson, Magliano, &

Smith, 2015). For example, in dynamic visual narratives, shorter shot lengths and higher motion direct viewer attention to the same things at the same time. This ‘attentional sychrony’ (Loschky et al) has implications for the activation of both relevant and irrelevant information (Magliano, Higgs, & Clinton, in press). Relevant information can facilitate inference generation, whereas irrelevant information will likely hinder inference generation. Thus, different media, depending on the patterns of activation they produce, will act as faciliators or as obstacles for inference generation and comprehension.

Further, an individual’s familiarity with (and fluency in attending to) different grammatical structures of static and dynamic visual narratives (e.g., Cohn, 2018; Cohn & Bender, 2017) might also influence inference generation. Such familiarity or fluency is an important prerequisite for the use of visual narratives to improve reading comprehension (Schwan & Ildirar, 2010).

Inferences can be prompted by questioning. Evidence that inference making can be prompted with questioning dates back to Graesser and Franklin’s (1990) cognitive model of question answering called QUEST, which specified information sources and mechanisms that are at play when answering questions. More recent evidence comes from numerous examples of question-based interventions focused specifically on inference generation during reading in elementary grades (see McMaster & Espin, 2017 for a review). Similarly, questioning is often used during book-sharing interactions and interventions such as ‘dialogic reading’ to develop inferencing in pre-schoolers (van Kleeck, 2008; Zevenbergen & Whitehurst, 2003). Consistent with the conceptualization of inferences as the activation and integration of information, questions have potential to prompt inferences because they: (a) ‘cue’ activation of relevant information, and (b) facilitate integration of that information, because integration is needed to answer the question.

Most important, such questioning is often coupled with scaffolding. Scaffolding typically incorporates cues, prompts, and corrective feedback (Golke, Dörfler, & Artelt, 2015). The rationale for including scaffolding along with questioning to support inference making is also consistent with the view that inference making involves activation and integration of information. Specifically, scaffolding has potential to reinstate or re-activate in a student's memory the relevant information needed to draw an inference. Feedback, namely information about whether the inference was successfully drawn (Kluger & DeNisi, 1996; Sadler, 1989), is also an important component of questioning (Hattie & Timperley, 2007; Kulik & Kulik, 1988).

In early intervention work, Carnine, Kame'enui, and Woolfson (1982a) compared the effects of different questioning approaches with scaffolding and feedback in fifth-graders. Their work showed that a prompting and questioning approach that led students to the appropriate inference was far more effective than asking students simply to answer the inferential question and providing corrective feedback. Carnine, Stevens, Clements, and Kame'enui (1982b) compared similar questioning and feedback approaches in fourth- through sixth-grade students. In this study, students in both questioning and feedback conditions performed better than controls, suggesting there may be value in also providing feedback. Other research on feedback also suggests that explicit feedback improves students' inference making (e.g., Winne et al., 1993).

More recent research has demonstrated that questioning interventions that focus on the content of text may support readers' comprehension. For example, McKeown, Beck, and Blake (2009) compared a content approach to strategy and basal-series approaches in two studies across two years in fifth-grade classrooms. In the content approach, at preselected stopping points, the teacher asked questions designed to focus student attention on the content of the text. In the strategies approach, the teacher prompted the students to use strategies to summarize, predict, draw inferences, generate questions, or monitor comprehension. In the basal-series approach, the teacher asked comprehension questions from the teacher's edition of the basal reader also at preselected points in the texts. Findings from both studies revealed an advantage of the content-focused approach over the other two approaches, supporting the idea that specific text-based questions help focus the reader's attention on information critical for building a coherent mental representation of text.

McMaster et al. (2012) examined whether the *type* of questioning influences students' inference generation, by comparing three types of questions asked during reading in fourth graders: *causal* (specific 'why' questions about the text), *general* (generic prompts to make connections within the text), and "*W"* (who, what, where, when) questions. The findings showed no differences among types of questioning. However, further analyses indicated that subgroups of readers who struggled with comprehension responded differently to the types of questioning. Specifically, readers who tended to over-rely on background knowledge while reading (termed "elaborators") responded better to the causal questioning approach, perhaps because causal questions directed them to relevant information in the text. By contrast, readers who tended to merely paraphrase as they processed text without making text-based *or* knowledge-based connections (termed "paraphrasers") responded better to the general questioning approach, perhaps because this approach prompted them to make connections beyond the immediate sentences they were reading. These findings suggest that different approaches to inference making instruction may be more or less beneficial for readers who experience different comprehension difficulties (McMaster et al., 2012).

More recently, McMaster et al. (2014; 2015) found that immediate feedback was critical for helping fourth-grade readers struggling with comprehension identify causal connections during questioning activities. Further, like Carnine et al. (1982a) found, immediate *scaffolded* feedback appeared to be more beneficial than direct feedback (i.e., in which the answer was merely provided rather than after scaffolding students' attempts to find the answer themselves). The rationale for an *immediate feedback* approach is that it may help students generate connections they missed, or update (and correct) incorrect connections before those become entrenched in their mental representations and hinder further comprehension and learning. This correction is particularly important in the context of answering cloze-type questions (for example, multiple-choice questions), as students often learn and retain the incorrect responses they initially provide if those are not corrected (Butler & Roediger, 2007; Roediger & Marsh, 2005).

Much of the intervention research examining the effects of questioning and feedback on children's inference generation has been conducted with upper-elementary students in reading contexts. In the iLC framework we propose that instruction focused on, or assessment of, inference making can be designed for young children, before they are proficient decoders of text, by leveraging affordances of visual narratives.

Leveraging Affordances of Visual Narratives for Instruction and Assessment of Inferential Processes

The iLC framework leverages the generalizability of inference making and the unique affordances of different media (text, static visual narrative, dynamic visual narrative) to inform the instruction and assessment of inference making in educational settings, particularly through the use of questioning with scaffolding and immediate feedback.

Media affordances. As mentioned above, mental models provide the basis of comprehension across different media (McNamara & Magliano, 2009), and there are likely shared cognitive systems that lead to the construction of these mental models (Cohn, 2018; Gernsbacher, 1990; Gernsbacher, Varner, & Faust, 1990; Magliano et al., 2007, 2016; Zacks & Magliano, 2011). Despite these shared processes, different media have different affordances in terms of which aspects of the mental model can be made explicit or the ease by which certain processes take place (Hutson, Magliano, & Loschky, 2018; Magliano et al, in press). Among these differences are unit of meaning, multimodality, and demands on vocabulary and knowledge (Magliano et al., 2013). We expect these differences to have implications for inference generation.

In text, a single sentence can include multiple clauses, each containing a subject and a verb phrase. Verbs are particularly important in conveying the events that unfold (Zwaan, Langston, & Graesser, 1995). In static visual narratives, a panel usually contains multiple characters engaged in one or more actions and events. Thus, a unit of meaning in a static visual narrative (i.e., a panel) can provide more opportunities for inference making than a unit of meaning in text (i.e., a sentence). For example, consider the panel in Figure 2. The panel includes three characters. In the first image, one character is stuck under a fallen timber, one is poised to help, and one is shocked and worried, all in the dark environment of a mine. To adequately convey this scene in text alone would require at least several sentences (or one very long sentence with multiple clauses). In the second image one of the characters is now outside and vividly happy. We can make the inference that they probably all made it out. To adequately convey this outcome in text alone would require several sentences.

-------------------Insert Figure 2 about here------------------

In text, linguistic processing is necessary for comprehension, whereas in static and dynamic visual narratives, the integration of both visual and linguistic processing (if the visual narrative also includes text) is necessary for comprehension. Thus, visual narratives can provide opportunities for generating inferences of higher complexity than texts, as they could involve the integration of linguistic and visual information in a static narrative or linguistic, visual, and sound information in a dynamic visual narrative. For example, dialogue between characters (linguistic information) could be supported by facial expressions and other body language (visual information) as well as amplified by sound (e.g., sad music) to express a variety of emotions that might be difficult to convey in text only. To illustrate, the second image of the character outside the mine in Figure 2 can convey several emotions, such as happiness and relief for having escaped a difficult situation (being trapped in the first image).

In text, language follows standard grammar, sentences include dependent clauses, and vocabulary demands are high. In static visual narratives (when they also include text), language follows a loose grammar, includes short sentences, and is accompanied by visuals to communicate and reinforce meaning. Because of these characteristics, comparable age-appropriate text and static visual narratives will impose different vocabulary and knowledge demands, with such demands in the context of text being higher than those in static visual narratives (Magliano et al., 2013).

We describe how differences in unit of meaning and multimodality can manifest in various inference processes in Table 1. *Anaphoric inferences* allow individuals to determine that a person or object in one sentence/panel/shot is identical to that in another. These inferences are routinely generated and develop early in a child's life. For example, by age 6 children are able to reliably recognize that a character in one image is the same as in a prior image—termed the 'continuity constraint' (Cohn, 2016). Older children and adults can also reliably resolve referents in oral or written texts without explicit training on how to do so (Gernsbacher, 1989). A single sentence, panel, or shot may include multiple objects, actions, and events. Thus, for anaphoric inferences the affordances of different media may have less than profound effects.

Bridging inferences allow individuals to connect the current idea to one that occurred earlier in the text/static visual narrative/dynamic visual narrative with minimal demands on background knowledge. These inferences are routinely made by adults, but require explicit instruction for young children. In texts, a bridging inference connects the contents of a current sentence to a sentence that came before. In static visual narratives, a bridging inference connects information within or across panels, with multiple permutations in modalities (e.g., text-to-text or text-to-image or image-to-image). In dynamic visual narratives, a bridging inference connects information within or across shots, with multiple permutations in modalities (dialog-to-sound, dialog-to-image, sound-to-image, dialog-to-sound-to-image, and so on). Furthermore, a single panel or shot may include multiple objects, actions, and events. Thus, for bridging inferences the affordances of dynamic visual narratives may provide far more opportunities for drawing inferences than do static visual narratives and texts, with texts providing limited opportunities.

Elaborative Inferences allow individuals to connect the current idea in the text/static visual narrative/ dynamic visual narrative to their background knowledge. In texts, an elaborative inference connects the contents of the current sentence to the reader's background knowledge in an effort to explain the current sentence. In static visual narratives, an elaborative inference connects information within or across panels to background knowledge, with multiple permutations in modalities (e.g., text-to-text or text-to-image or image-to-image). In dynamic visual narratives, an elaborative inference connects information across shots to background knowledge, also with multiple permutations in modalities (dialog-sound-image to background, dialog-to background, image-to-background, sound-to-background, and so on). Furthermore, in static and dynamic visual narratives, multimodality may explicitly or implicitly cue the relevant background knowledge for comprehension. Thus, for elaborative inferences the affordances of static and dynamic visual narratives may reduce opportunities for drawing inferences that are central to comprehension than in texts. At the same time, the presence of multiple objects, actions, and events in single panels or shots may also provide additional opportunities for drawing inferences that are not central to comprehension.

Finally, *emotion inferences* allow individuals to determine a character's mental state. These inferences may be readily facilitated in static and dynamic visual narratives because of the inclusion of images and/or sound and dialog that can portray the consequences of internal states. Emotion inferences may be harder to draw in texts because they will likely pose greater demands on background knowledge. Thus, for emotion inferences the affordances of different media may influence both the opportunity and the probability of generation.

-------------------Insert Table 1 about here------------------

To our knowledge, there is little research examining how media affordances (text, static visual narrative, dynamic visual narrative) influence the generation of different types of inferences (for emerging work on bridging inferences in static visual narratives, see Hutson et al., 2018). Thus, the predictions in Table 1 should be considered tentative. It would be important for future research to evaluate how the unique affordances of different media influence both the moment-by-moment processes and the probability of generating different types of inferences.

Assessment. The first implication of iLC relates to the assessment of inference skill in young children even before the beginning of formal reading instruction. Because a child's inference skill generalizes across different media, iLC may capitalize on the use static and dynamic visual narratives to assess the child's ability to generate different types of inferences. Thus, such assessment might be used for diagnosis of students who experience difficulties in inference generation early on, so that this skill can be subsequently and appropriately developed through targeted interventions. To assess inference skill in young children, we have drawn on the aforementioned work to develop the Minnesota Inference Assessment (MIA). MIA is a web-administered assessment designed to evaluate inference skill in a non-reading context by using age-appropriate fiction and nonfiction dynamic visual narratives of approximately 5 min in runtime. Students answer inferential questions in one of two conditions: in one condition, inferential questions interrupt the narrative at each point at which an inference is needed for comprehension (*online*); in the other condition, the inferential questions immediately follow the narrative (*offline*), thereby eliminating interruption. Questions are presented via a pedagogical agent, after which the student selects one of four possible answer options presented audio-visually. Importantly, assessments such as MIA that leverage the affordances of dynamic visual narratives and evaluate a general skill also have the potential to be appropriate for English Learners (ELs) as well as adults learning to read since they require no decoding. Preliminary evidence indicates that MIA can produce reliable scores that relate to other established measures of language and reading comprehension (Butterfuss, Bresina, McMaster, & Kendeou, 2018).

Instruction. The second implication relates to the types of strategy interventions that might be used with young children to build inference skill. We have drawn on the iLC framework to develop two personalized instructional systems. The first is Early Language Comprehension Individualized Instruction (ELCII), and the second is Technology-Based Early Language Comprehension Intervention (TeLCI). ELCII is designed to *support* reading comprehension by training inference making for all students in Kindergarten, whereas TeLCI is designed to *improve* reading comprehension by training inference skills for students who experience comprehension difficulties in Grades 1-2.

Neither ELCII nor TeLCI rely on decoding skills, but instead leverage the affordances of static and dynamic visual narratives to train inference making. Both ELCII and TeLCI include 24 modules, which engage students to learn key academic *vocabulary* words and requisite prior knowledge, view age-appropriate dynamic visual narratives (12 *fiction*, 12 *nonfiction*), respond (by touch screen selections) to *inferential questions* (to prompt bridging and elaborative inferences), and receive personalized *scaffolding* and *feedback* for each question (following conditional branching). Both ELCII and TeLCI facilitate transfer of inference skills with either *whole-class* or *small-group* lessons that involve teacher-led book-reading using static visual narratives and inferential questioning parallel to that provided in the modules.

Each learning module in ELCII and TeLCI is embedded in a cloud-based software application that is *personalized, fully automated, and interactive*. It is personalized with computer adaptive algorithms, which facilitate the use of sophisticated branching in scaffolding and feedback. The interactivity is supported by a visual *pedagogical agent*, which is the 'face and voice' of the instructions, questions, and feedback in each learning module (see Figure 3 for a sequence of the core components). The agent was designed to function as a fictional, more knowledgeable peer whose mission is to help each child learn how to make inferences. Preliminary evidence indicates that both ELCII and TeLCI can be feasibly implemented in a classroom setting and improve language comprehension outcomes (McMaster & Kendeou, 2018). Like MIA, personalized instructional systems such as ELCII and TeLCI, which leverage the affordances of visual narratives (static and dynamic), also have the potential to be appropriate for ELs of all ages as well as adults who experience comprehension difficulties, since they require no decoding.

-------------------Insert Figure 3 about here------------------

Conclusions and Future Directions

The development of the new tools discussed above represents innovation in the assessment, instruction, and intervention of comprehension skills that are general, such as inference making. These tools capitalize on technology, which has only recently become widely available in educational settings, to provide a usable and feasible way to offer high-quality assessment, instruction, and intervention to a high volume of students. These tools also leverage the affordances of static and dynamic visual narratives to assess and facilitate growth in inference skill. However, many open questions remain that must be addressed in future work.

One question pertains to the factors that could potentially moderate the effects of interventions and instructional tools such as TeLCI and ELCII, as these could inform for whom and under what conditions growth in inference skill is most likely to occur. For example, differences in cross-culture fluency of static and dynamic visual narratives as a result of exposure (Cohn, 2016) raise an important question about how such fluency may moderate intervention effects. Indeed, an important assumption in our work is that comprehenders who engage with these tools have had prior exposure, and thus proficiency with visual and/or dynamic visual narratives. How much prior exposure is sufficient, however, is largely unknown. Related, a deeper understanding is also needed about how aspects of visual narrative comprehension, such as inference making, may be more or less difficult for certain individuals because of other cognitive impairments (see Coderre in this issue for a discussion on this issue).

A second question pertains to transfer. These interventions include both static and visual narratives in an effort to leverage the affordances of each in training inference skills. While these affordances may provide opportunities for inference training in various contexts, they may also limit transfer across contexts. Understanding better the conditions under which such transfer can be effectively facilitated remains an important question for future research in this field, but also in education more broadly.

Addressing questions like these could sharpen the focus and aid further development of future tools to support comprehenders who experience difficulty with the demands of 21st century literacy skills. Open questions aside, the potential of visual narratives in this context cannot be overstated.

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Table 1

Inferential Processes Across Media

Inferential Processes	Text	Static Visual Narrative (picture book)	Dynamic Visual Narrative (film)
Anaphoric Inferences (determine that a person or object in one sentence/panel/shot is identical to that in another)	Integrating information within and across *sentences*	Integrating information *across panels* (image-to-image)	Integrating information *across shots* (dialog-sound-image to dialog-sound-image)
Bridging Inferences (bridge the current idea to one that occurred earlier in the text/static visual narrative/ dynamic visual narrative)	Integrating information across *sentences*	Integrating information *within a panel* (text-to-text or text-to-image or image-to-image) Integrating information *across panels* (text-to-text or text-to-image or image-to-image)	Integrating information *within a shot* (dialog-to-sound, dialog-to-image, sound-to-image or dialog-to-sound-to-image) Integrating information *across shots* (dialog-sound-image to image, dialog-sound-image to dialog, dialog-sound-image to sound, or dialog-sound-image to dialog-sound-image)
Elaborative Inferences (bridge the current idea in the text/static visual narrative/ dynamic visual narrative to background knowledge)	Integrating information in a *sentence and background knowledge*	Integrating information *across panels* with background knowledge (text-to-text-to knowledge or text-to-image to knowledge or image-to-image to knowledge)	Integrating information *in a shot with background knowledge* (dialog-sound-image to background knowledge, dialog-to background knowledge, image-to-background knowledge, sound-to background knowledge)
Emotion Inferences (determine the mental state of a character)	Integrating information across *sentences* or a *sentence* and *background knowledge*	Integrating information in *a panel with background knowledge* (text-to-knowledge or image-to-knowledge)	Integrating information *in a shot sequence (e.g., a point-of-view sequence)* (image-to-image or image-to-sound or dialog-to-image) or in a *shot and background knowledge*

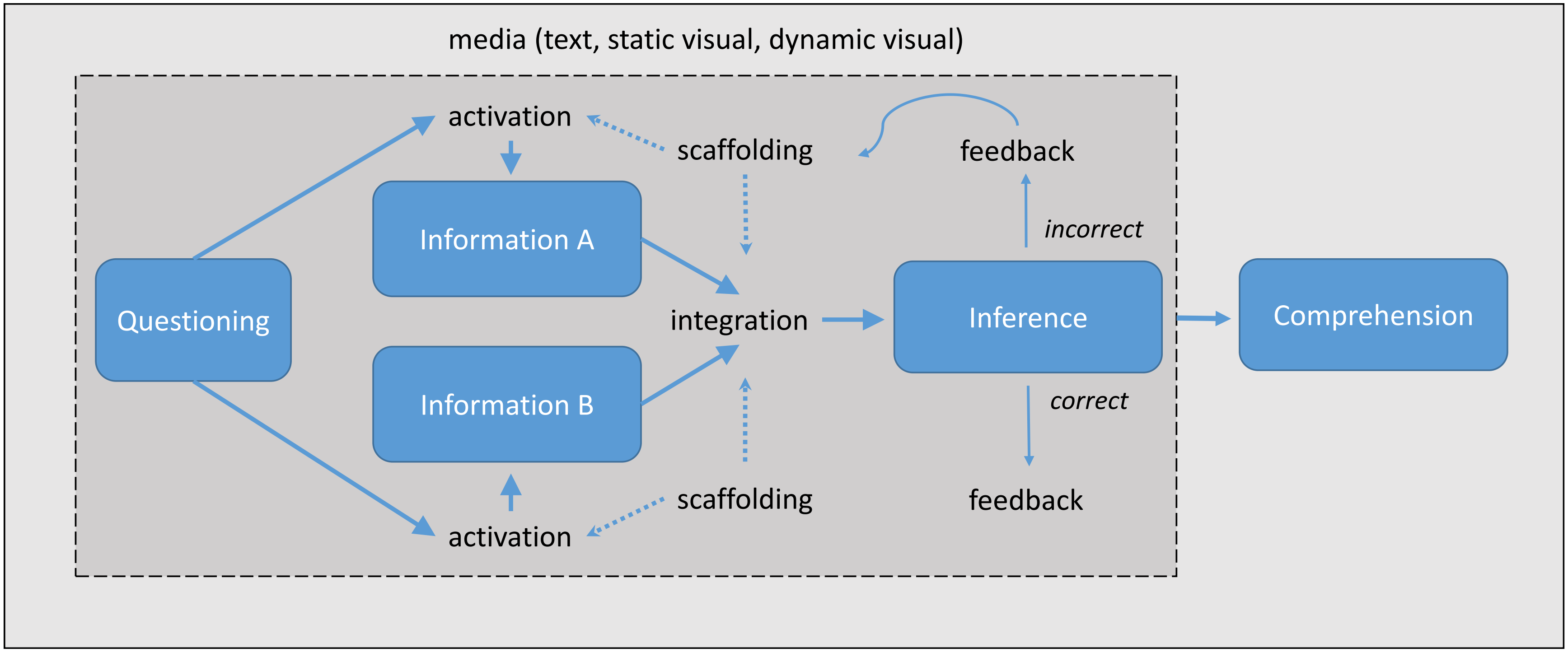

Figure 1. ***The Inferential Language Comprehension (iLC) Framework***

Figure 2. ***An Illustration of the Affordances of a Static Visual Narrative***

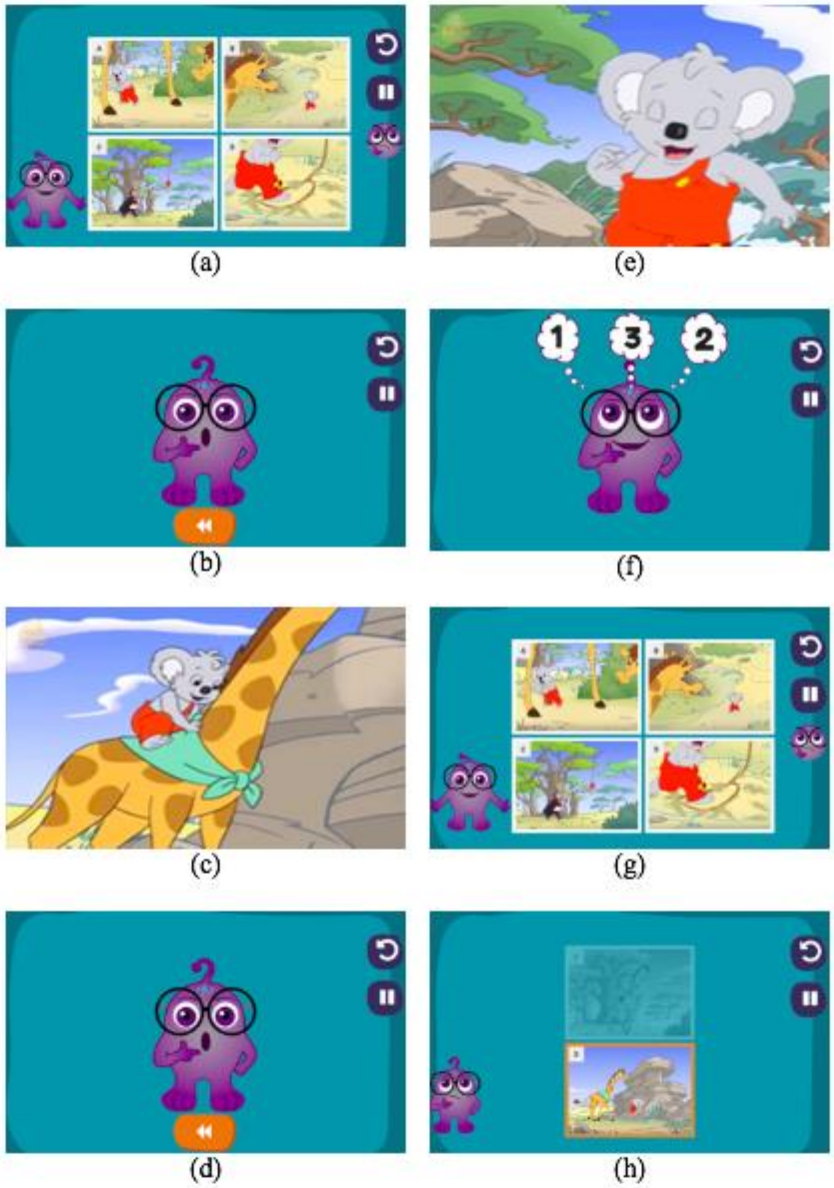

Figure 3. ***Question, Scaffolding, and Feedback Sequence in ELCII/TeLCI*****.** (a) first question asked, (b) first scaffold audio, (c) first scaffold visual, (d) second scaffold audio, (e) second scaffold visual, (f) integration of two scaffolds audio, (g) second time question is asked, (h) visual response with audio feedback.

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