Visual Representations of Narratives for Poor Comprehenders

Tania Di Mascio, Rosella Gennari, Alessandra Melonio, and Pierpaolo Vittorini

Abstract. Poor comprehenders are children with specific reading impairments. Several reading interventions for them, evaluated in the literature, use images for representing textual information in narratives. Our paper overviews several such studies, and highlights current findings and shortcomings in the literature. The results of the overview can be taken up for designing specific evidence-based visual representations of narrative information for poor comprehenders.

Keywords: evidence-based design, visual representation, users with special needs.

1 Introduction

Nowadays, more and more children in that age range turn out to be poor (text) comprehenders: they demonstrate difficulties in deep text comprehension, despite well developed low-level cognitive skills like vocabulary knowledge, e.g., see [1, 2]. In particular, they seem to have problems in making inferences for answering questions like who, what and where, as well as for correlating events narrated in the text in a coherent causal-temporal model.

Pictorial aids can help children to comprehend specific textual information, and answer such questions, problematic for poor comprehenders. In this paper we overview several experimental studies which assess the effect of pictorial aids on the text comprehension of poor comprehenders.

The skeleton of this paper is briefly given as follows. The subsequent section lays the groundowrk: it overviews the common functions of images for texts. Next, the paper reports on field studies with poor comprehenders, experimentally

Tania Di Mascio
University of L'Aquila, DIEI, Via G. Gronchi, 18 – 67100, L'Aquila, Italy

Rosella Gennari · Alessandra Melonio
Free University of Bozen-Bolzano, CS Faculty, P.zza Domenicani 3, 39100 Bolzano, Italy

Pierpaolo Vittorini
University of L'Aquila, MISP, V.le S. Salvatore, Edificio Delta 6 – 67100, L'Aquila, Italy

P. Vittorini et al. (Eds.): International Workshop on Evidence-Based TEL, AISC 152, pp. 91–98.
springerlink.com

evaluating the role of visual representations with specific functions for text comprehension. The paper concludes by assessing the evidence available in the literature for recommending specific visual representations for key features of events and causal-temporal relations in texts, whose textual comprehension is problematic for poor comprehenders.

2 Visual Representations and Narrative Comprehension

Our compact overview of the literature concerning visual representations for narrative comprehension starts with the work reported in [4], and extended in [5, 6]. Levie et al. analyse the literature on pictures for the comprehension of text, and classify pictures into five types of functions for text comprehension:

1. decoration, if the pictures only decorate the text;
2. representation, if the pictures give a representation of the text concepts;
3. organisation, if the pictures organise the information conveyed by the text, e.g., via diagrams;
4. interpretation, if the pictures interpret difficult passages or concepts;
5. transformation, if the pictures transform and alter the text meaning, usually to aid recall.

Table 1. recaps such types of functions, with their advantages, disadvantages and the effect on text learning as analysed in [5, 8].

Table 1 The Levie types of functions of images for text comprehension, and their analysed effects on text learning

Function type	Description	Effects on text learning
Decoration	no direct connection with the prose content	null
Representation	telling exactly the same story as the words; overlapping substantially with the text	moderate
Organisation	providing an organisational framework, e.g., diagrams	moderate to substantial
Interpretation	visually interpreting difficult-to-understand passages and concepts	moderate to substantial
Transformation	codifying difficult textual information into a visual metaphoric format that should easy the memorisation of the difficult textual information	substantial

In particular, according to the analysis of Levie et al., pictures that complement the text information being presented increase the likelihood for retention and recall of that information, and hence have substantial effect on learning text. On the

other hand, decorative images, not related to the text contents, tend to have no effect on retention and no prose-learning facilitation is to be expected

Starting from the work of Leive et al., Marsh and Domas [7] identify, organise and integrate other functions of images for text comprehension. In their work, images are grouped according to the degree of relation they bear with the text:

1. images that have no relation with the text, e.g., for decoration,
2. images that bear a close relation with the text, e.g., for representation, see Fig. 1,
3. images that interpret or transform the text, e.g., for organisation, interpretation, or transformation, see Figg. 2, 3.

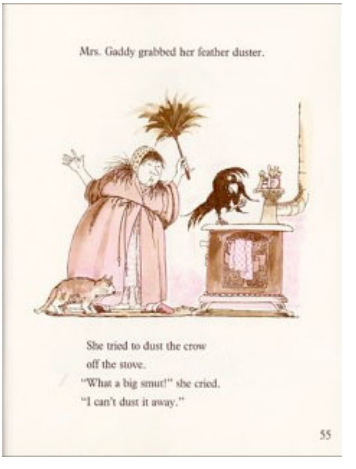

Fig. 1 An example of a representational image from [16]

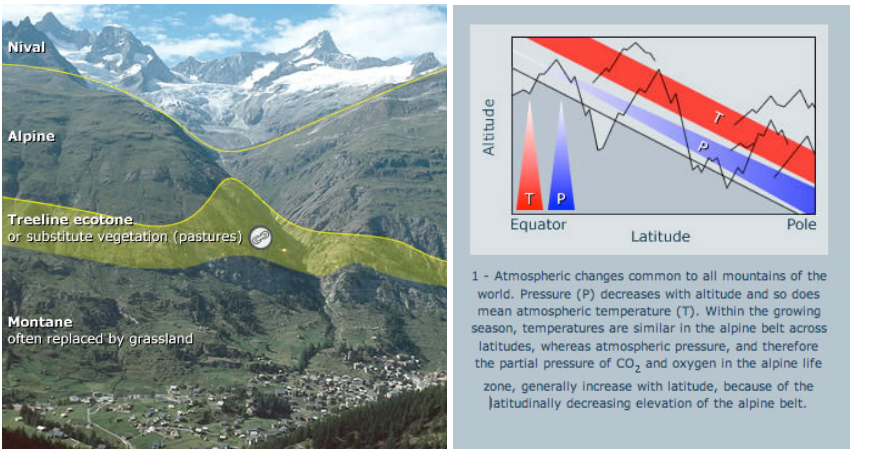

Fig. 2 An organisational pic (on the left) and an interpretational image (on the right) from [16]

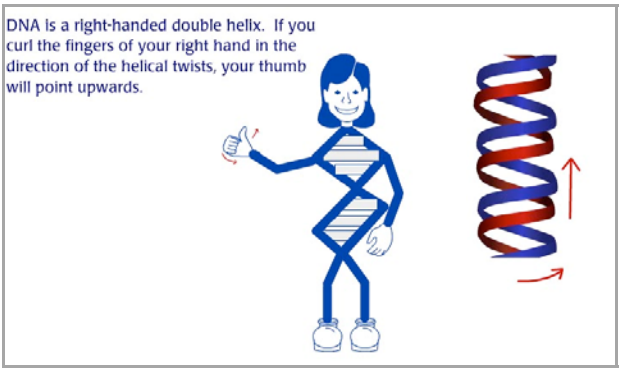

Fig. 3 An example of a transformational image from [16]

The result is a taxonomy of functions of images for text that can be used for analysing the way that images interact with text. It is applicable to all subject areas and all types of documents. We present the taxonomy in Fig. 4, from which we can derive the five functions of images with respect to text analysed by Levie et al. For instance, the decorate concept in the taxonomy in Fig. 4 can be associated to the decorative function of Levie et al; reiterate can be associated to the representation function; organise, interpret and transform can be associated to the Levie et al. functions of organisation, interpretation and transformation.

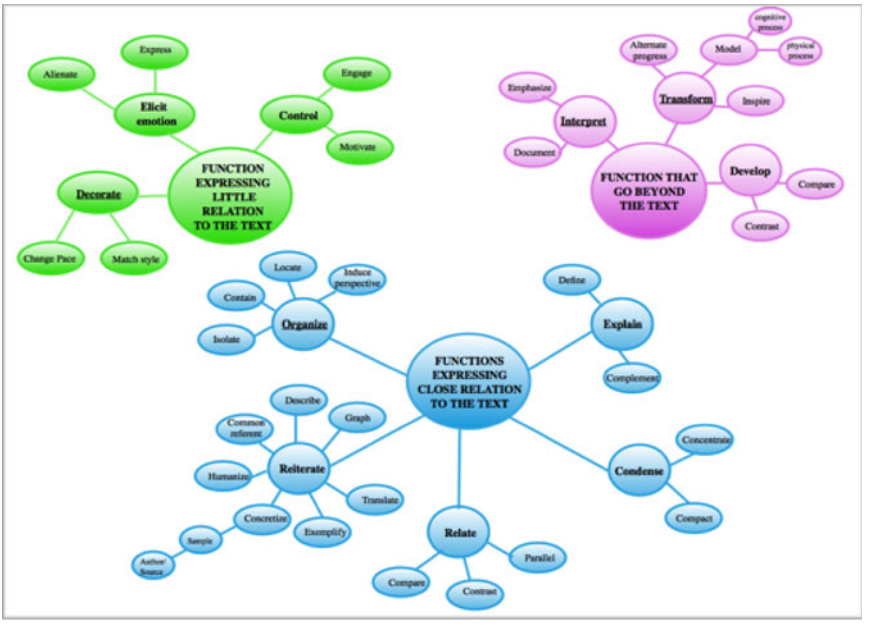

Fig. 4 The taxonomy of Marsh and Domas.

In addition, the taxonomy can be used for assessing the use of images comparatively across documents, for example, assessing the functions played by illustrations in scientific texts and perhaps relating the functions to the effectiveness of the texts for learning or retention of information.

3 Visual Representations for Text Comprehension and Poor Comprehenders

According to the dual coding theory [2, 3], learning is improved when the information is referentially processed through two channels: one for verbal information such as text or audio, the other for nonverbal information such as illustrations and sounds in the environment. Successful readers do this dual coding automatically, for instance through mental imagery. Mental imagery is the process of creating images "in one's mind" while reading. A good deal of research on mental imagery demonstrates that learning of text is enhanced when students are prompted or taught to use mental imagery. In particular, training poor comprehenders to mental imagery by representing specific information in narratives via specific types of visual representations, as good comprehenders do, can be a way to improve the poor comprehenders understanding of narratives [14, 12]. Not surprisingly, perhaps, mental imagery also aided in differentiating good from poor readers.

Table 2 lists several studies concerning training children to mental imagery, aged 7 to 10 years. The table reports the participants in the test, the material used, the training and assessment methods, the reported effects on comprehension. The following acronyms are used in the table and hereafter in the paper:

- GC: good comprehenders;
- PC: poor comprehenders;
- TD: typically developing children;
- SLI: specific language impairment.

Table 2 Recap of experimental studies concerning mental imagery with children

Users	Age	Author	Material	Training	Assessment	Comprehension
GC vs PC	8	Pressley (1976) [13]	Representational images, text	Physical pictures; sentences with major elements of the text	Questions	Substantial improvement to answering questions

Table 1 (*continued*)

GC vs PC	9-10	Oakhill & Patel (1991) [14]	Tranformational images	Mental pictures	Questions: factual, descriptive, inferential	Imagery group: GC (25) PC (14) Control group: GC (24) PC (13) Substantial improvement on factual and inferential question	
GC vs PC	9-10	Gambrell& Bales (1986) [12]	3 high imagery, 2 high-imagery paragraphs, 4 short expository passages, 10-item probing instrument	Two passages with explicit and implicit inconsistency; instruction to induce mental imagery	Questions concerning inconsistencies	Detect the implicit inconsistency: imagery group, 65%; control group, 29%. Control group failed to detect the explicit inconsistencies (71%) and the implicit inconsistencies (73%)	
GC vs PC	9-10	Gambrell& Jawitz, (1993) [11]	Representational images. Text both with illustration and not	Mental imagery and illustration Only illustration Only mental imagery	Free recall; clue recall questions	Mental images and illustrations may similarly affect cued recall. The combined strategy use results in deeper processing than is achieved with single strategy use.	
TD vs SLI	9	Joffe, Cain & Maric (2007) [15]	Stories presented to the children both verbally and visually; written questions	Form representational images	Questions: factual, inferential	Improvement of 125% in factual; 47% in inferential	
						Pre test factual: SLI (7,5) TD (17) Pre test Inferent.: SLI (8) TD (22)	Post test inferential: SLI (18) TD (23) Pre test Inferent.: SLI (12) TD (20)

In brief, as exemplified by Cain in [15], the training to mental imagery is an effective way to boost the story comprehension of children with reading impairments. The mental imagery training helped such children to answer questions about short narratives. The improvement was greatest for so-called factual w-questions, that is, concerning facts explicitly narrated in the story. Mental imagery aided the children's memory of explicit details in the text. Moreover, as Cain speculates, the training to the creation of mental images to support text comprehension is immediate and unobtrusive and therefore may be more readily accessible to and accepted by children in the classroom context.

4 Discussion and Conclusions

According to our review of the literature, briefly sketched above, as well as brainstorming meetings conducted with experts of poor comprehenders within the TERENCE EU project and with experts of pedagogy within the DARE project, there are currently no studies concerning *specific* visual representations of narrative events and their causal-temporal relations for poor comprehenders. In spite of this, there are lessons one can learn from the current evidence in the literature, overviewed in this paper, which suggests the direction to move along for designing specific visual representations of events and their relations, aiding their comprehension, for the TERENCE and DARE projects.

First of all, as reported in Section 3, the mental imagery *training* through representational or transformational images significantly helped readers with specific language impairments, like poor comprehenders, to answer factual w-questions concerning events of short narratives. This can be immediately taken over by DARE and TERENCE for designing interventions focusing on features of the narrated events, e.g., who is involved in a specific event narrated in a story.

The lack of a significant impact on inferential processing of this study does not detract from the finding that a relatively short period of training boosted the recall of content dramatically for those struggling readers. Possibly, this lack of impact may also be due to the fact that the training was often done with representational or transformational images. Based on this and the empirical review of [5], we speculate that *organisational* and *interpretative* visual representations, often used in children science textbooks for representing causal or causal-temporal relations, may aid deep text comprehension and, in particular, inference-making of information concerning causal-temporal relations in a narrative. Therefore, the next step of our work foresees the design of visual organisational and interpretational visualisations of causal-temporal relations, based on metaphors used in science textbooks for children, within DARE, and hence their development within TERENCE, The subsequent step of our work is the user-centred-design evaluation of the representations with experts of the domain, and then with 8-11 old poor and good comprehenders in small scale studies.

Moreover and more in general, the training to the creation of mental images for supporting text comprehension is immediate and unobtrusive and therefore may be more readily accepted by poor comprehenders in an educational context, as envisioned in the TERENCE project.

Acknowledgments. The authors' work was supported by TERENCE project, funded by the EC through the FP7 for RTD, Strategic Objective ICT-2009.4.2, ICT, TEL. The contents of the paper reflects only the authors' view and the EC is not liable for it. The second and third authors' work was also funded through the DARE project, financed by the Province of Bozen-Bolzano.

References

1. Najjar, L.J.: Dual coding as a possible explanation for the effects of multimedia on learning (GIT-GVU-95-29). Georgia Institute of Technology, Graphics, Visualization and Usability Center, Atlanta (1995a)
2. Paivio, A.: Dual coding theory: Retrospect and current status. Canadian Journal of Psychology 45, 255–287 (1991)
3. Paivio, A., Csapo, K.: Picture superiority in free recall: Imagery or dual coding? Cognitive Psychology 5, 176–206 (1973)
4. Levie, W.H.: Research on pictures: A guide to the literature. In: Willows, D.M., Houghton, H.A. (eds.) The Psychology of Illustration. Basic Research, vol. 1, pp. 1–49. Springer (1987)
5. Levin, J., Anglin, G., Carrney, R.: On empirically validating functions of pictures in prose. In: Willows, D.M., Houghton, H. (eds.) The Psychology of Illustration. Basic Research, vol. 1, pp. 51–85. Springer (1987)
6. Levie, W.H., Lentz, R.: Effects of text illustrations: A review of research. Educational Communications and Technology Journal 30(4), 195–232 (1982)
7. Marsh, E., Domas White, M.: A taxonomy of relationships between images and text. Journal of Documentation 59(6), 647–672 (2003)
8. Carney, R., Levin, J.R.: Pictorial illustrations still improve students learning from text. Educational Psychology Review (2002)
9. Marschark, M., Sapere, P., Convertino, C., Mayer, C. W.L., Sarchet, T.: Are Deaf Students' Reading Challenges Really About Reading? (in Press)
10. Gambrell, L.B., Jawitz, P.B.: Mental imagery, text illustrations, and children's story comprehension and recall. Reading Research Quarterly 28, 264–276 (1993)
11. Gambrell, L.B., Bales, R.J.: Mental imagery and the comprehension-monitoring performance of fourth- and fifth-grade poor readers. Reading Research Quarterly 21, 454–464 (1986)
12. Pressley, G.M.: Mental imagery helps eight-year-olds remember what they read. Journal of Educational Psychology 68, 355–359 (1976)
13. Oakhill, J., Patel, S.: Can imagery training help children who have comprehension difficulties? Journal of Research in Reading 14, 106–115 (1991)
14. Joffe, V.L., Cain, K., Maric, N.: Comprehension problems in children with specific language impairment: does mental imagery training help? International Journal of Language and Communication Disorders 42, 648–664 (2007)
15. Hibbing, A.N., Rankin-Erikson, J.L.: A picture is worth a thousand words: Using visual images to improve comprehension for middle school struggling readers. Reading Teacher 56(8), 758–771 (2003)
16. Images, `http://www.dnaftb.org/`