

Images and Memory: A Literature Review of Issues in the Use of Images to Aid Vocabulary Acquisition and Reading Comprehension and Recall

Marcel VAN AMELSVOORT

ABSTRACT

Many Japanese high school teachers of English do not make use of images in classes, despite the fact that images have been shown to be more memorable than text. This article covers research in memory, L1 (first language) reading, and multimedia learning to see understand how images can aid in the acquisition of written language and reading comprehension ability in preparation for designing studies on the use of images in EFL (English as a foreign language) teaching and learning situations.

Introduction: Could a thousand written words be better?

A picture is worth a thousand words. This bit of popular wisdom suggests that images contain more information than text and that this information can be more easily processed and understood by the observer. More than ever before, written prose is likely to be accompanied with images (David, 1998), suggesting that the effectiveness of images in communicating—or at least getting attention—is widely accepted. Textbooks in schools make extensive use of images to facilitate learning. And new multimedia materials for use in classrooms, on PCs, or in e-books for mobile devices go beyond that, integrating text with both still and moving images. The combination is often visually stunning. But does it improve language learning?

Open any English language textbook in Japan and you will find images—lots of them. A quick survey of the main units of two of the most popular EFL textbooks in Japan (used for English I with first year high school students) found an average of 2 images per page, occupying in some cases as much as 40 to 90 percent of some pages. And textbook makers are employing greater use of images in their materials it seems. A similar quick survey of two popular EFL textbooks for English I used 25 years ago, found an average of 1.02 images used per page. Publishers must think images are more important these days; they are using twice as many as 25 years ago.

In contrast, teachers at high schools in Kanagawa in Japan do not seem to be making significant use of textbook images or other images in their classes, according to observations done in and around November of 2012. Classroom observations and examinations of teaching

materials were done for thirteen teachers taking part in the year-long Advanced Program for high school English teachers at Kanagawa Prefectural Institute of Language and Culture Studies. The program itself had stressed the use of images and multimedia (using presentation software) in several sessions. However, only six of the teachers used any images in class at all. The image use of two of these six teachers consisted of a single image drawn on the blackboard at one point during the lesson. None of the teachers directed student attention to images in textbooks in any of the lessons observed. In addition to not making use of the images in the textbook and not bringing other images into the classroom, twelve of the thirteen teachers created worksheets to use in classes in place of textbooks. These sheets contained transcriptions of textbook text along with comprehension questions and translations and *no images at all*. These worksheets focus learner attention to text features but completely remove the visual support textbook makers provide. The result is classrooms largely devoid of images for learning. Many teachers in Kanagawa it seems do not consider images an integral tool for English language teaching.

What are the possible reasons for this? First and foremost, teachers and students share a common first language (L1). In classrooms, using that L1 for definitions, explanations, and translations is efficient and it is no surprise that teachers believe they can explain the details and nuances of almost anything in the L1. Also, there is in secondary school classes in Japan a strong focus on linguistic competence, on grammar and vocabulary. In a context where most tests—both achievement tests in school and proficiency tests outside of school—are text-based and reading-focused, it is not surprising that teachers have come to see their job as getting learners familiar with the written form of the language. Even if a teacher does use images, ultimately, learning English successfully for academic purposes in Japan requires familiarity with the written form above all else. It has been this way for a long time, and most of the students, most of their parents, and even most of the teachers themselves have not experienced a different style of institutional language lessons.

But is that a problem? Do images do anything vital? In order to consider greater use of images in classrooms in Japan, one very important question needs to be answered: do pictures actually help with the learning of foreign language *literacy* at the secondary school level, given that learners already have a good command over their L1 and possess a considerable amount of world knowledge? The purpose of this paper is to examine the literature across some related disciplines to look for an answer that question. Over the years, there have been a lot of assumptions about images and learning based on research in a wide variety of disciplines. In considering the research on memory, L1 reading, multimedia learning, and L2 multimedia learning, we'll also consider some of the theories underlying how learning may be happening

with images to look for some possible direction for further research into if and how images can benefit EFL teaching and learning.

Early research: Amazing memory for images

More than forty years ago, studies revealed that human memory (recall and recognition) for images is vastly superior to memory for other modes (Paivio, Rogers & Smythe, 1968; Stenberg, Radeborg, & Hedman, 1995). The human visual processing system is indeed impressive. Pictures can be semantically categorized faster than words (Potter and Faulconer, 1975). Humans are able to recall as many as 2,500 images (Standing et al., 1970). And not only is the number of items impressive, but subjects are able to remember the images in subtle detail (Brady, Konkle, Alvarez & Oliva, 2008) for longer, with 90% recall three days later and 63% recall a year later (Nickerson, 1968); impressive results have been found even after 20 or 30 years (Read and Barnsley, 1977). The recall and recognition superiority of pictures over text or auditory content has been well documented and is called the *picture superiority effect* (PSE). The reasons for PSE are still being debated (Miller, 2011), but it seems clear that somehow images are processed differently. “The memorial representation of pictures is in some way more elaborate, distinctive, or meaningful than the representation of words” (Hockley, 2008, p.1351). One explanation is that images may be processed more semantically ‘deeply’ (Craik and Tulving, 1975; Craik and Lockhart, 1972). Another very widely accepted theory is Paivio’s (1971) *dual coding theory*. According to this theory, when visual information enters the brain via the eyes, it triggers the sound associated with the name of the thing in the image, leading to dual processing of both the visual and verbal information with one reinforcing the other. Thus observers of images are getting multichannel and multiple representations of content information. Whitehouse, Maybery & Durkin (2006) found that the magnitude of PSE increased with age as children moved from childhood (grades 2-3) to adolescence (grades 10-11). They concluded that PSE “...is dependent upon dual coding and that this in turn is dependent upon the use of inner speech” (p. 772).

For EFL learners, this raises some potential issues. When images call up inner speech in EFL students, that speech is likely to be in the L1, leading to possible confounding information that could slow or inhibit processing and thus learning. Ogasawara (1995), however, when he examined the use of pictures to facilitate comprehension and recall of prose listening information in Japan found that images had a positive effect. Recall of images after a single exposure was equal to recall of recorded text after two exposures. Whatever the exact mechanism, Paivio’s dual coding theory or something else, EFL learners seem to experience similar recall and recognition benefits from images as people do in their first language.

Images contain more information than text. But both images and words contain associations with their location and surrounding items, and trigger emotions in the subject. When pairs of pictures are shown to subjects, they recall the images, but also the combinations that were presented (Hockley, 2008). And the emotional content of images also affects memory results: "...recall and recognition is more likely for emotional than neutral [images]" (Mather & Nesmith, 2007). Interestingly, though, Kesinger & Corkin (2003) found the same effect with emotional vs. neutral words, though the effect does not seem to be as great as for images. Arousal, it seems can increase both attention to the word or image and attention to certain features the word or image has (Mather & Nesmith, 2007). This suggests a web of associations and associated information with images varying in emotional arousal level.

What is missing in these studies of words vs. images is context. In a very general way, image processing trumps that of text. But humans do not go about life neutrally. Context and purpose are important. Schnotz & Bannert, (2003) state: "Text comprehension and picture comprehension are goal-oriented processes of the human cognitive system, in which the individual actively selects and processes verbal as well as pictorial information in order to construct representations that seem to be suited to cope with the present or anticipated task" (p. 153). Miller (2011) found that the task subjects engage in while they are exposed to images or text has a great influence over subsequent recall. He questions Paivio's theory because he did not find evidence that images automatically call up their names that are then encoded verbally. Instead, he surmises that semantic and verbal coding may happen only when the subject finds it purposeful for task performance.

Research on images for L1 literacy development: A complex relationship

Reading is a goal-oriented task. The relationship between images and text in learning from printed materials is complex. Read and Barnsley (1977) when examining recall of images and text of first-grade reading textbooks decades later found that images only were recalled better than text only, but images together with text were recalled best of all. They surmised that "...a child's memory of the materials includes both verbal and pictorial content in an interactive sense. Indeed, the recognition of the verbal passage would appear to depend in a large part upon the availability of the picture" (p. 368). Images can help with recall of text content and vice versa.

Research from the use of images in teaching beginning reading shows a fairly clear trend: images are good for overall language skills development but don't help all that much with

learning to read (Evans, Williamson & Pursoo, 2008; Carney & Levin, 2002). The image of a child on a parent's lap with a picture book open is generally associated with an important stage of literacy development. Shared picture book reading fosters semantic development through imaginative content, novel vocabulary, and different sentence structures. Children spend the time listening carefully, looking at pictures, and interacting with the book and the reader. But the child is not looking at the text—not attending to letters and sounds and not directly learning to read—through this experience. Less than 2% of that 'reading' time is directed at text on average Evans, Williamson & Pursoo (2008) found, and pointing out images and text when reading books to 3, 4 and 5-year-olds has different effects. Once emergent literacy skills have developed (phonemic awareness, etc.), pointing out text in picture books leads to better recall of printed content. But during the initial stages of extracting words and meaning from texts, pictures actually distract attention from text and inhibit reading development (Carney and Levin 2002).

Once literary skills have developed to a certain level, the exact effects on readers of deploying images depend on the text type, the reading proficiency and schema level of the readers, the task type, and the image type (Waddell & McDaniel, 1992). "Pictures enable the extraction and retention of information—[details or relational information]—that readers, under ordinary circumstances, do not encode well enough to recall" (p. 481). Pictures can thus serve to alert and direct reader attention to specific text content. This improves recall both for less and more-proficient readers. Everyone except for the absolute beginner readers, it seems, gets a recall bump from images. It is especially true when the content is concrete rather than abstract (David, 1998)—though it is important to qualify this with the fact that concrete words are also recalled better than abstract words (Endestad et al., 2003). This effect seems to hold true for children, and both younger and older adults (Cherry, Dokey, Reese, & Brigman, 2003), but for older (i.e., more proficient readers) there is improved recall of content when verbal elaborations are used as well.

But improved recall of text details is only one reason to deploy images. Fang (1996) identifies six roles that images can play in storybooks: establishing settings, defining or developing characters, developing the plot, providing a different viewpoint, contributing to overall story/text coherence, and reinforcing the text. To this list, we can add a few other roles. One is certainly raising the attractiveness of the book or unit. Images attract attention and interest, and break up the text, making the printed pages look more accessible (Mendelson & Darling-Wolf, 2009), especially to less proficient readers. While none of these directly help learners learn to decode words on the page, they certainly contribute to comprehension, a richer enjoyment, and to "...the overall development of children's literate behavior" (Fang, 1996, p.

136).

Different types of images can play different roles when used along with text. Carney and Levin (2002) in a review of image use studies identify five types of images, all of which except decorative images can help with text learning (comprehension and recall). They provide guidelines gleaned from research for using images, both general and specific depending on the variables involved. For low proficiency readers, images can help build up listening comprehension and general language skills but should be avoided when teaching very early reading skills. For other learners, images are good for complex topics or with low-schema learners as long as the content of the images overlap with the content in the text. There are some caveats, however: related text and images need to be placed nearby each other in time and space and some task or activity is needed to direct students to noticing image features. Different images can be used for different purposes (making a text more concrete, comprehensible, coherent, or encodable, etc.) and care needs to be taken in selecting the best image based on the type of image, type of text, type of learners, and performance outcomes.

Aside from just presenting images along with text, there is an important role for images prior to exposure to the target text and images of a book or unit. It is well established that learners in possession of certain schematic knowledge find it easier to comprehend, organize, and recall subsequent text/image information content consistent with that schema (Silva et al., 2006; Stango and Ruble, 1989). The use of advance organizers, usually images, to build or activate that schema is one technique widely used that attempts maximize text learning by building schematic knowledge (Ausubel, 1978).

There is now a fairly large body of literature available to guide educators and textbook makers, though often the ‘experts’ are unaware of this, ignore it, or fail to implement the guidelines correctly (Benson, 1995). Research suggests that images and text are perceived and processed differently from each other but that each influences the other. Images tend to be more concrete, specific to a certain time and place (Mendelson & Darling-Wolf, 2009), and because they are processed more quickly, responses to images are generally more immediate and emotional (Hill, 2004). But images are not good at communicating some concepts: negatives, propositions, and conditionals, for example (Messaris, 1994). It seems clear that images can play a large, but not all-powerful, role in text learning, if they are deployed and manipulated effectively—that means if they are chosen carefully for a purpose, introduced at the best time, and are accompanied by some task that directs student attention to the relevant features.

Multimedia and EFL: Images and text in digital delivery

Beginning in the 1990s, a large amount of research emerged from the application of cognitive learning theory to emerging multimedia and Internet technology. There was great interest in this new e-learning technology from the worlds of corporate and military training as well as from institutes of higher education who were looking for new ways of delivering instruction in both regular and distance programs (Clark & Mayer, 2003). A number of findings emerged, which Mayer (2001) drew up into a list of principles that has become a basis for research and instructional design. Within these principles, we find some relevant to the use of images with text for learning. Though not originally meant for language instruction, the *multimedia principle* (people learn better from words and pictures than words alone) and the *split-attention principle* (words and pictures are most effective when physically and temporally integrated) have been applied and investigated in e-learning language courses (Mayer, 2005). Another theory that has had a great influence on the multimedia design is the *cognitive load theory* (Sweller, 1994), which describes limitations of human processing capacity for information in working memory and techniques for surmounting those limitations (verbal: 4-7 pieces of information; spatial: 4 pieces of information (Xu & Chun, 2006)). These include building schematic knowledge (see also Ausubel, 1978 on advance and visual organizers), techniques for chunking or grouping information pieces, and finding the best mode combinations to optimally present information to prevent overload.

One of the problems with looking at images and text in EFL multimedia is that there are many approaches to teaching languages (cognitive, constructivist, and sociocognitive/sociocultural, for example) (Plass and Jones, 2005), and many ways that images and text are used in the long process of learning a language. However, if we consider the dominant functions that are generally assumed to be critical for language learning success, comprehensible input (Krashen, 1982), interaction (Long, 1985), and comprehensible output (Swain, 1985) we can get a rough idea of how multimedia can be used "...to support the comprehensible input that the learner is exposed to and interacts with, and to elicit and negotiate comprehensible output" (Plass & Jones, 2005, p. 469).

Research into use of images for vocabulary teaching has found that in general, images help with vocabulary acquisition and do so better than just text (Plass & Jones, 2005). Displaying the image before the written presentation has been found to increase retention (Brown, 1993). Most research, however, has focused on annotations. These are explanations available to learners as they work through written or audio text, generally in the form of hyperlinks available for items

in the text. With minimal interruption, the learner can quickly access a written definition (in the L1 or L2) or image (still, video, or animation) illustrating the item. Research has generally found that images are better than words only, but definitions for key words in both pictorial and text form is best of all (Chun & Plass, 1996a; Jones & Plass, 2002; Yoshii & Flaitz, 2002). Mohsen and Balakumar (2011) offer two theories for why this happens: Paivio's *dual coding theory* and Mayer's *multimedia principle*. But here the inner verbal message produced when subjects are exposed to images that lead to multiple representation in the brain is ignored; rather, in the world of language learning, it seems to be assumed that learners will hear the sound (or read the adjacent text label) and see the image at the same time, resulting in 'dual' processing. This seems to be a questionable application of the theory. The second, Mayer's *multimedia principle* seems to be a better fit, at least until what is happening in the EFL learner's brain is better understood. "The availability of text and pictures allows learners to construct verbal and visual mental models of the input and build connections between them" (Plass & Jones, 2005, p. 480). This allows learners more options for comprehension, and more than one route for encoding, and retrieval (Jones, 2009). In EFL classrooms, it is often expedient to provide annotations in the L1 for vocabulary learning. Yoshii (2006) compared L1 and L2 written annotations with and without pictures. Results showed that both L1 and L2 glosses were useful, but that picture plus text (either L1 or L2) proved to be similar to just text on immediate post-tests and more effective on delayed post-tests.

In recent years, research has revealed important differences between learner styles/preferences and performance in recall studies. High and low spatial and verbal ability differences in learners have been tested and found to be significant (Jones & Plass, 2002; Jones, 2009). Though research results are still mixed (depending on the type and timing of the tests), allowing learners to choose their preferred mode of support (visual or verbal) has been associated with better learning, particularly over longer stretches of time (Plass et al. 1998; Jones, 2009; Mohsen & Balakumar, 2011) and Plass and Jones (2005) state that the effect is strong enough to be called an *individual difference principle*. Explanations for this mention cognitive load theory (Sweller, 1994), visual and verbal short term memory differences between subjects (Xu & Chun, 2006), as well as individual learning styles or preferences. Learners appear to have preferences that may be the result of working memory capacity differences for both verbal and visual stimuli. Up to a point, providing both stimuli can allow multi-channel processing, but too much of one or the other can result in overloading and less learning. This may be what is happening to low proficiency learners (Jones, 2009). One other finding that is of importance for us is that performance is better for vocabulary recall tests when the testing mode matches the treatment mode (Jones, 2004). Thus, if your intention is to prepare learners for an

upcoming written vocabulary test, using written input is better.

Another area that has been the subject of several studies regarding multimedia image use is with advance organizers (Ausubel, 1978). Advance organizers can be video or images or audio or written texts (summaries, questions, etc.) that activate and/or build schema for topics or linguistic features. In general, learners acquire language better when they view an advance organizer before being exposed to the main or target written or audio text input. This allows them to more easily integrate information/linguistic features with existing knowledge (Plass and Jones, 2005). Any type of advance organizer can help but providing images (video) with text has been associated with the most positive results (Herron et al., 1995).

Conclusion

The basic conclusion we can draw from all the research covered is that use of images in language teaching can be beneficial, depending on the goals for learners and the timing and method of deployment. So what direction can we take away from this research regarding the use of images with the learning of foreign language literacy at the secondary school level, given that learners already have a good command over their L1 and possess a considerable amount of world knowledge? In the direct day to day preparation of learners to take written tests, images may arguably be of limited use. But that type of teaching itself should be considered of limited use in the overall development of L2 literacy and proficiency. Granted, many target lexical items do not lend themselves to pictorial depictions (for example non-concrete items such as “responsibility”, or many lexical stems such as “as a matter of fact”). It is easier to provide written L1 translations for these, something that can be done efficiently and not ineffectively in most EFL classrooms. But images have proven themselves to have distinct advantages in aiding comprehension, encoding, and recall, particularly in the long term (Ogasawara, 1995). They can be used to support text content effectively and draw attention to target features, including target language. They can also be used to efficiently activate or build schema, get attention, elicit emotional reactions, and reduce anxiety in low proficiency learners. But the exact effect depends to a large degree on how they are used. It is getting easier and easier to deploy images in classrooms thanks to increasingly widespread availability of ICT tools and resources (Internet, computers, projectors, wireless connections, and mobile devices). Creating visual advance organizers, visual flashcards, or leveraging images through techniques such as See Think Wonder (Ritchhart, Church and Morrison, 2011) and the Picture Word Inductive Model (Calhoun, 1999) are now easier than ever before. More research is needed in the area of images in language teaching and learning. The exact mechanism of image/language processing in the brains of EFL learners needs to be explored more, especially the role of the L1 and L2 when

visual stimuli are encountered. Also, the area of individual differences with learning styles/working memory capacity needs to be better understood. And finally, the potential of emotions and images is not well understood but seems to offer interesting possibilities.

References

- Ausubel, D. (1978). In defense of advance organizers: A reply to the critics. *Review of Educational Research* Vol. 48, No. 2 (Spring, 1978), pp.251-257
- Benson, P. J. (1995). Problems in picturing text. *Diss. Abstr. Int. Sec. A: Humanities* *Sci* 55(11-A): 3357
- Brady, T. F., Konkle, T., Alvarez, G. A. and Oliva, A. (2008). Visual long-term memory has a massive storage capacity for object details. *Proceedings of the National Academy of Sciences, USA*. vol 105 (38), 14325-14329.
- Brown, C. (1993). Factors affecting the acquisition of vocabulary: Frequency and saliency of the words. In T. Huckin, M. MHaynes, & J. Coady (Eds.), *Second language reading and vocabulary learning* (pp. 263-286). Norwood, NJ.: Ablex.
- Calhoun, E.F. (1999). *Teaching beginning reading and writing with the picture word inductive model*. Alexandria, VA: ASCD
- Carney, R. N. & Levin, J. R. (2002). Pictorial illustrations still improve students' learning from text. *Educational Psychology Review*, 14(1), 5 – 26.
- Cherry, K.E., Dokey, D., Reese, C.M., & Brigman, S. (2003). Pictorial illustrations enhance memory for sentences in younger and older adults. *Experimental Aging Research*, 29, 1-18.
- Chun, D. & Plass, J. (1996a). The effects of multimedia annotations on vocabulary acquisition. *The Modern Language Journal*, 80, 183-198.
- Clark, R. and Mayer, R. (2003). *E-learning and the science of instruction*. San Francisco CA: Pfeiffer.
- Craik, F.I.M., & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General*, 104, 268-294.
- Craik, F.I.M., & Lockhart, R.S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, 11, pp. 671-684.
- David, P. (1998). New concreteness and visual-verbal association: Do news pictures narrow the recall gap between concrete and abstract news? *Human Communication Res.* 25: pp. 180-201.

- Endestad, T., Helstrup, T., & Magnussen, S. (2004). Source memory for pictures and words following literal and metaphorical decisions. *Imagination, Cognition and Personality*, 23(2&3), pp. 209-2016.
- Evans, M. A., Williamson, K., & Pursoo, T. (2008). Preschoolers' attention to print during shared book reading. *Scientific Studies of Reading*, 12, pp. 106-129.
- Fang, Z. (1996). Illustrations, Text, and the Child Reader: What Are Pictures in Children's Storybooks for? *Reading Horizons*, V37. N2. pp.130-42.
- Herron, C, Hanley, J., & Cole, S. (1995). A comparison study of two advance organizers for introducing beginning foreign language students to video. *The Modern Language Journal*. Volume 79, Issue 3, pp. 387–395.
- Hockley, W. (2008) The picture superiority effect in associative recognition. *Memory and Cognition* 36 (7), pp.1351-1359.
- Jones, L.C., & Plass, J.L. (2002). Supporting listening comprehension and vocabulary acquisition with multimedia annotations. *The Modern Language Journal*, 86, pp. 546-561.
- Jones, L. (2004). Testing L2 vocabulary recognition and recall using pictorial and written test items. *Language Learning and Technology*, 8(3), pp. 122-143.
- Jones, L. (2009). Supporting student differences in listening comprehension and vocabulary learning with multimedia annotations. *CALICO Journal*, 26(2), pp. 267-289.
- Kesinger, E. & Corkin, S. (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory & Cognition*, Vol. 31, Issue 8, pp. 1169-1180
- Krashen, S. (1982). *Principles and practice in second language acquisition*. New York: Pergamon.
- Long, M. (1985). Input in second language acquisition theory. In S. Gass and C. Madden (eds.), *Input in second language acquisition* (pp. 377-393). Rowely, MA: Newbury House Publishers
- Mather, M & Nesmith, K. (2007). Arousal-enhanced location memory for pictures. *Journal of Memory and Language*, Vol. 58, Issue 2, pp.449-464.
- Mayer, R. (2001). *Multimedia learning*. New York: Cambridge University Press.
- Mayer, R. (2005). Introduction to multimedia learning. In *the Cambridge handbook of multimedia learning*, R. Mayer ed. New York: Cambridge University Press.
- Mendelson, A., & Darling-Wolf, F. (2009). Reader's interpretations of visual and verbal narratives of a National Geographic story on Saudi Arabia. *Journalism*, 10, pp. 798-818.

- Messaris, P. (1994). *Visual literacy: Image, mind, and reality*. Boulder Co: Westview Press.
- Miller, P. (2011). The processing of pictures and written words: A perceptual and conceptual perspective. *Psychology*, Vol. 2, No. 7, pp. 713-720.
- Mohsen, M. and Balakumar, M. (2011). A review of glosses and their effects on L2 vocabulary acquisition in CALL literature. *ReCALL* Vol. 23, Issue 2, pp. 135-159.
- Nickerson, R. (1968). A note on long-term recognition memory for pictorial material *Psychonomic Science*, 11(2): 58 .
- Ogasawara, S. (1995). Using pictures to facilitate EFL students' comprehension and recall of unillustrated prose information in listening comprehension practice. *Bulletin of the Faculty of Liberal Arts, Nagasaki University*, 35, pp. 367-381.
- Paivio, A. (1971). *Imagery and verbal processes*. New York: Holt, Rinehart & Winston.
- Paivio, A., Rogers, A., & Smythe, P. (1968). Why are pictures easier to recall than words. *Psychonomic Science*, Vol 11(4), 1968, pp. 137-138.
- Plass, J.L., Chun, D.M., Mayer, R.E., & Leutner, D. (1998). Supporting visual and verbal learning preferences in a second language multimedia learning environment. *Journal of Educational Psychology*, 90, pp. 25-36.
- Plass and Jones, (2005). Multimedia learning in second language acquisition. In *The Cambridge Handbook of Multimedia Learning*, R. Mayer ed. Cambridge: Cambridge University Press.
- Potter, M. and Faulconer, B. (1975). Time to understand pictures and words. *Nature* 253, pp. 437 - 438
- Read, J. & Barnsley, R. (1977). Remember Dick and Jane? Memory for elementary school readers. *Canadian Journal of Behavioral Science*, Vol 9(4), pp. 361-370
- Ritchhart, R., Church, M., & Morrison, K. (2011). *Making thinking visible*. San Francisco: Jossey-Bass.
- Sadoski, M. (2008). Dual coding theory: Reading comprehension and beyond. In C. C. Block & S. R. Parris (Eds.), *Comprehension instruction* (2nd ed.) pp. 38-49. New York: Guilford Press.
- Schnotz, W. & Bannert, B. (2003). Construction and interference in learning from multiple representation. *Learning and Instruction*. Vol. 13, Issue 2, pp. 141-156.
- Silva, M., Groeger, J., & Bradshaw, M. (2006). Attention-memory interactions in scene perceptions. *Spatial Visions* 19(1): 9-19
- Standing, L., Conezio, J., & Haber, R. N. (1970). Perception and memory for pictures: Single-trial learning of 2560 visual stimuli. *Psychonomic Science*, 19, 73-74.

- Stangor, C., & Ruble, D. (1989). Strength of expectations and memory for social information: What we remember depends on how much we know. *Journal of Experimental Social Psychology* 24: pp. 18-35.
- Stenberg, G. Radeborg, K. & Hedman, L. (1995). The picture superiority effect in a cross-modality recognition task. *Memory & Cognition*, Vol. 23, Issue 4, pp. 425-441
- Swain, M. (1985). Communicative competence: Some roles of comprehensible input and comprehensible output in its development. In S. Gass & G. Madden (Eds.) *Input in second language acquisition* (pp. 235-253). Rowley, MA: Newbury House Publishers.
- Sweller, J. (1994). Cognitive Load Theory, learning difficulty, and instructional design. *Learning and Instruction* 4 (4): 295–312.
- Waddell, P. and McDaniel, M. (1992). Pictorial enhancement of text memory: Limitations imposed by picture type and comprehension skill. *Memory & Cognition*, Vol. 20, Issue 5, pp. 472-482.
- Whitehouse, Maybery & Durkin, (2006). The development of the picture superiority effect. *British Journal of Developmental Psychology*, Vol. 24, Issue 4, pp. 767-773.
- Xu, Y., & Chun, M. (2006). Dissociable neural mechanisms supporting visual short-term memory for objects. *Nature*, Vol. 440, pp. 91-95.
- Yoshii & Flaitz, (2002). Second language incidental vocabulary retention: The effect of text and picture annotation types. *CALICO Journal*, 20(1), pp. 33-58.
- Yoshii (2006). L1 and L2 glosses: Their effects on incidental vocabulary learning. *Language Learning and Technology*, Vol. 10, No. 3, pp. 85-101.