

Embodied EFL reading activity: Let's produce comics

Ruei-Fang Shiang
National Taiwan Normal University
Taiwan

Abstract

While theories of embodied cognition have been investigated in lab experiments with proficient readers, currently no studies have applied these theories to improving reading comprehension for low-proficiency readers. Using an embodied cognition approach, this study investigated producing comics as an embodied reading activity. To compare effects on English as a foreign language (EFL) reading comprehension of narrative texts, 71 low-proficiency tertiary EFL readers were randomly assigned to one of two collaborative post-reading activity groups: comics production or translation. Before the activities, the participants were given background knowledge instruction for the narrative texts. Reading comprehension was assessed by a true-false test, followed by a semi-structured focus group interview. The results show that the comics production group outperformed the translation group in reading comprehension. Moreover, evidence from interviews shows the comics production activity assisted low-proficiency EFL readers in constructing multimodal representations of what they read, improving the depth of their reading comprehension.

Keywords: embodied cognition, situation models, multimodal, EFL reading comprehension, learner-generated illustrations, comics, translation

The mental model construction theory has been infused with new findings over the past two decades, for example from grounded (embodied) cognition (i.e., Barsalou, 1999b; Bower & Morrow, 1990; Zwaan, 1999), but little work has been done to apply embodied cognition directly to EFL reading instruction. One reason is that translation strategies still prevail within the EFL realm, despite the fact that neuroscience studies have shown the brain locations involved in processing translation and reading are different at both the word level and the sentence level (Lehtonen et al., 2005; Price, Green, & von Studnitz, 1999). The present study therefore aimed to explore the impact of embodied cognition on EFL reading instruction via a comics production activity, comparing its effects on EFL reading comprehension to those of a translation activity. All instructional activities were administered to collaborative learning groups to encourage higher-level reasoning and a stress-free learning environment (Richards & Rodgers, 2001).

Translation and EFL Reading Comprehension

Translation has been found to be one of the most common strategies used by EFL learners with varying English proficiency levels to facilitate their English reading comprehension (Huang, Chern, & Lin, 2009; Zhang & Wu, 2009). Among EFL Chinese adults, low-proficiency learners are particularly inclined to utilize a word-by-word translation strategy when reading English texts (Lin & Yu, 2013). As EFL students rely heavily on translation, the representations they construct for a text might be confined at either the surface level, which is a word-by-word structure, or at the textbase level, which represents the meaning of relevant information as explicitly mentioned in the text—that is, factual information (Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). Despite the fact that reading and translation do not share the same neurocognitive circuits (Borius, Giussani, Draper, & Roux, 2012), many EFL teachers and learners strongly believe that translation is an effective and efficient strategy for EFL reading comprehension and instruction (Kuzborska, 2011; Liao, 2006).

Visual Effects of Self-Generated Illustrations on Reading Comprehension

Visualization, especially self-created external illustrations (i.e., drawings), is another strategy used to enhance reading comprehension (McNamara, Ozuru, Best, & O'Reilly 2007). Studies on the effectiveness of visualization for improving reading comprehension are conflicting, however. Van Meter (2001) recruited first language (L1) young readers to investigate whether self-generated drawing improves reading for learning. The participants were assigned to one of four instructional conditions: reading only (control group), participant-generated drawing, viewing experimenter-provided pictures, or participant-generated drawing with varying levels of assistance. The results of the comprehension tests showed that the control group's comprehension was the worst, while the participant-generated drawing with supplementary assistance group had the best comprehension scores. The participants in the picture-viewing group and in the drawing group achieved equal comprehension. In a similar study, Hall, Bailey, and Tillman (1997) showed that when L1 college students received self-generated drawing instruction, their reading comprehension was as good as those shown pictures but better than those receiving no instruction.

In contrast, Snowman and Cunningham's (1975) college-aged L1 readers demonstrated that drawing did not benefit reading comprehension. Likewise, Leutner, Leopold, and Sumfleth (2009) showed that self-generated drawing was not beneficial to text comprehension for L1 adolescents as compared to those in a reading-only group. Schwaborn's research team (2010) ascribed the contradictory effects of self-generated illustration on reading comprehension among the aforementioned studies to inconsistencies regarding the amount of supplementary assistance given to students during the drawing activity. Van Meter and Garner (2005) also suggested that observing the effectiveness of self-created external visualization requires assessments measuring deep understanding, for example, the problem-solving test in Hall et al. (1997), rather than assessments measuring factual knowledge, such as the multiple-choice recognition test in Leutner et al. (2009). In this view, the multiple-choice retention test used in Schwaborn's research team (2011) should not have revealed a positive effect of self-generated external illustrations on reading comprehension since the study's measurement target was factual

knowledge. Considering the conflicting results of these studies, the rationale that inspired these studies should be explored.

Mental Models and Embodied Cognition

Self-generated external visualization is highly regarded as a method to support readers in constructing mental models of what they read (Kintsch, 1994; Van Meter & Garner, 2005). Mental models, also known as situation models, are the representations of situations described in a text, created by readers and then elaborated on using prior knowledge (Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). Barsalou (1999b) suggested that mental representations are multimodal, including actions, introspections (i.e., emotions, etc.), and perceptions. Thus, comprehension occurs when multimodal experiences relevant to a present situation are simulated by a reader (Barsalou, 1999a; Zwaan & Radvansky, 1998). Past experiences can also be modified to suit a given situation and then be simulated by a reader to provide a better understanding (Barsalou, Simmons, Barbey, & Wilson, 2003).

Scholars of embodied cognition (e.g., Barsalou, 1999a; Zwaan, 1999) suggested that meaning is an integration of referent representations (e.g., for infants, in what circumstances do they cry, what are their crying sounds, how do people interact with them, etc.) and linguistic representations that denote the referent (e.g., the motor acts when one pronounces or writes the word “infants”, one’s perceptions when hearing or reading that word, etc.). From this perspective, reading comprehension can be seen as a process of multimodal mental simulations of past experiences that integrate how one interacts with the real world as well as the relevance of past experiences to textual content (Barsalou, 2008; Zwaan & Rapp, 2006). It should be noted that it is not the exact past experiences that are mentally reenacted during reading. Instead these relevant actions, perceptions, and introspections from the past are modified and then simulated based on the situations or events described and delineated in a given text. Furthermore, individual readers can construct different mental representations for any given event described in a text, and one’s comprehension varies to the extent that the reader’s personal experience is related to the textual content at hand (Taylor & Zwaan, 2009).

Applying embodied cognition to EFL reading instruction is promising since many experiments have already demonstrated that mental simulations occur in reading comprehension (Zwaan, 1999). For instance, when readers in Zwaan and Madden’s (2005) study read a sentence that implicitly described an object’s orientation (e.g., She hammered the nail into the wall.), and were presented with a picture illustrating an object whose orientation either matched the orientation implied in the sentence (in this example, a horizontal nail) or mismatched the implied orientation (in this example, a vertical nail), results showed participant responses in the naming task were faster when the orientation in the picture matched the orientation implied in the sentence. Likewise, Zwaan, Stanfield, and Yaxley (2002) investigated readers’ perceptions of an object’s shape that was not depicted in the given text (e.g., a lemon in a bowl or glass). Again, the readers’ responses were slow when incongruity occurred between the shape of the object implied in the text and that shown in the pictures. Overall, these studies suggest that readers use multimodal and situated simulations and construct situation models to comprehend explicit and implicit information of a given text at a high standard (Borghini, 2004; Taylor & Zwaan, 2009).

Instruction of Embodied Cognition for L1 Reading Comprehension

Multimodal situation models are automatically simulated by proficient L1 readers (Zwaan, 1999). However, they are not necessarily simulated, or otherwise not consistently simulated, by low-proficiency L1 readers (Zwaan & Brown, 1996). As such, one reason previous studies may have failed to show the benefit of self-generated drawing instruction on reading is that an overemphasis from experimenters on exact object illustrations during instruction actually inhibited the proficient L1 readers from simulating and constructing multimodal representations (Van Meter & Garner, 2005).

In order to encourage the simulation of multimodal representations and improve young (low-proficiency) L1 readers' reading comprehension, Glenberg, Gutierrez, Levin, Japuntich, and Kaschak (2004) invented a method of instruction based on the Indexical Hypothesis. As one of the foundational works in embodied cognition, Glenberg and Robertson's (1999) Indexical Hypothesis claims that language comprehension requires readers to index words and phrases to referents (e.g., objects). Once the indexing is complete, affordances of the objects or potential interactions that happen in specific situations can be retrieved and derived. For example, if the object is a Hoover vacuum, affordance refers to how one manipulates or interacts with a Hoover in the real world. Later, based on syntax, readers can integrate affordances to simulate a given text's content, namely, who did what when (e.g., a janitor turned on a Hoover to vacuum all the dust after a crazy flat party). In short, simulations for the comprehension of a text's content emerge from the three processes delineated by the Indexical Hypothesis.

Glenberg et al. (2004) conducted three experiments each containing three different reading instructions and one control condition: manipulating toys representing referents from a given text, imagined toy manipulation, rereading, and no activity (control). The readers' comprehension of the text's factual information and their inferences regarding the text's content were assessed by a yes-no test, a free recall, and a cued recall. The results showed that the readers who performed actual (physical) manipulations scored higher on the factual knowledge tests and the inference test compared to those in the rereading, control, and imagined manipulation conditions. The readers in the imagined manipulation condition performed better than those in the rereading and control groups. However, the beneficial effect of imagined manipulation on overall reading comprehension was revealed only after the participants received training several times, while the actual (physical) manipulation group always outperformed the other groups. In brief, the actual manipulation group's success indicates that merely adding a modality (i.e., physical action, in addition to visualization) improved low-proficiency readers' comprehension. Additionally, externally presenting mental representations had a relatively immediate facilitating effect on the low-proficiency learners' reading comprehension compared to those producing internal (imagined) representations.

The Present Study

Comic strips, as one form of external illustration, are recognized for their advantages in reading comprehension (e.g., Wright & Sherman, 1994). These advantages are based on the understanding that comic strips are used as supplementary materials to main reading texts,

however, and are limited to the comic strips' visual and verbal modalities (e.g., Liu, 2004). To the best of the author's knowledge no EFL study has probed the effects of learner-generated comics on learners' reading comprehension, and no studies have explored the application of embodied cognition on EFL reading instruction. Considering the vivacious illustrations characteristic of comics, a connection between embodied cognition and producing comics is likely to exist. This exploratory study thus aims to explore the following research questions:

1. Are there any performance differences in reading comprehension among low-proficiency EFL readers when they engage in different reading instruction activities, for example producing translations vs. producing comics?
2. How can these two instructional activities (i.e., translation and producing comics) influence the participants' reading comprehension?

Method

Participants

Two classes of elementary English proficiency level Freshmen English (FE) students from two universities in northern Taiwan participated in this study. In order to assign students to the proper English proficiency level of FE, one of the universities relied on participants' TOEIC scores, while the other university used its own English proficiency test to assess English reading and listening abilities. Within each class, the students were randomly allocated to different instruction groups for this study. Thirty-five participants were in the comics production group (CG) and thirty-six were in the translation group (TG). Both the TG and the CG in each class were divided into three subgroups. The performances of students allocated to the TG whose L1 was not Chinese and who were not Chinese Language and Culture majors were excluded from the present study. All of the participants (male = 41, female = 30) were non-English majors. Four of them were Japanese and advanced Chinese speakers majoring in Chinese Language and Culture, and the rest were all native Chinese speakers. The participants were asked to take an authentic but retired IELTS Academic Reading Test to indicate their English reading ability (CG: $M = 10.46$, $SD = 1.80$; TG: $M = 11.11$, $SD = 1.70$). All participants in both groups scored below 15 on the test, indicating that they were not modest users of English reading (see ielts.org for *The IELTS Scoring in Detail*).

Materials

At both of the two universities, Anderson's (2013) *Active Skills for Reading: Book 2* was used as either a school-assigned textbook or supplementary reading material at the elementary level in FE. This study selected two narrative texts from the book (i.e., Unit 4-2 and Unit 5-2) as the shared reading materials for both instruction groups. The topic of Unit 4-2 was *The Unbeatable Yani Tseng* (460 words), which describes the journey of a Taiwanese female golfer who became an internationally-known golfing icon and how she learned English. Unit 5-2 was *Seeing with the Ears* (357 words), which describes how a visually-impaired boy overcame visual challenges by developing a special skill called echolocation.

Instruction

The instruction consisted of two phases for both the CG and the TG participants: shared instruction followed by post-reading group activities. In the shared instruction phase, the students were asked to preview a given reading article before meeting to study it in class. As per the usual pre-reading requirements administered by the elementary-level FE lecturers in the two universities, all the students had to consult a dictionary for the definitions and usage of vocabulary assigned in the article and make sentences for these words as homework. During class, the instructor used online videos to provide the students with background knowledge, followed by a class discussion of the videos' content. For Unit 4-2, the video was an off-course interview with the golfer Yani Tseng talking about her golf career, and the video for Unit 5-2 was a demonstration of how a blind boy walked in his neighborhood using echolocation, accompanied by a brain scan explaining a blind person's brain activity while using echolocation. Later, the students were randomly selected to read aloud sentences or paragraphs from the text and show the definitions and student-made example sentences for the vocabulary. After the shared instruction, each instruction group began their respective post-reading activity during which student discussion was in Chinese.

TG's activity. Translating English passages into Chinese is the most common activity in an elementary level FE class and was the fixed test task on the final exam. In this study, participants in the TG were informed that the purpose of this activity was neither word-by-word translation nor the training of professional translators. Instead, their translation should be reflective of their comprehension of the given article's intended meaning. The instructor also told them that their work would be shared with the other TG subgroups in the future. At the beginning of the activity, all the members in each TG subgroup discussed with each other their ideas on how to best translate the first paragraph in the article. They continued until they decided on a single translation for the paragraph. During the activity, the instructor did not give any guidance. The whole process proceeded one paragraph after another until all the paragraphs in the article were discussed. After class, group members were responsible for typing a part of the translation. They then combined their work into a final translation and submitted it to the instructor at the next class meeting.

CG's activity. At the beginning of the activity, the members in each CG subgroup were asked to communicate with their team members to discuss how they would illustrate each paragraph's content in their comics. Discussion continued until they reached a unanimous decision on how to create illustrations that corresponded to the text and were relevant and appropriate in representing the paragraph's content. The whole procedure repeated for each paragraph in turn until all the paragraphs in the article were discussed. After class, members were responsible for creating their respective parts of the subgroup's comic illustrations for the article. The instructor did not offer any advice during the activity, but told them that their work would be shared with the other CG subgroups in the future. Moreover, the instructor informed all the CG subgroups that aesthetics was not the focus of their comics and that their reading comprehension of the article would be revealed through their production of comics for that article. When all the members in each CG subgroup finished their respective parts of the comics, they combined their panels into a final comic strip and submitted it to the instructor at the next class meeting.

Instruments

True or false reading test (RTF). A dichotomous test—RTF—was adopted from Glenberg et al.'s (2004) study. The test was comprised of 12 items that assessed the participants' comprehension of the factual knowledge mentioned in the two articles. Half of the 12 items measured Unit 4-2's content and the other items measured the content of Unit 5-2. There were two versions of this test, differing only in the order of the items (See Appendix A). The reliability estimates for the RTF revealed an acceptable level: the Kuder-Richardson-20 = .79.

Post-experiment focus group interview. While audio-visual recording could have also been used to investigate how the two types of instruction activities influenced their respective participants' reading comprehension, this study adopted only a post-experiment focus group interview. This is because the learners' natural behavior (i.e. discussion in their respective instruction activity) could be disrupted by the presence of digital recorders in the classroom (Margaret, Roller, & Lavrakas, 2015; Seliger & Shohamy, 1989). The subgroups interviewed were only those whose work either showed special features that the others did not have or included vague expressions in the comics or translations. Four subgroups from each of the two classes were interviewed. The interview was administered in Chinese and was a post-experiment interview since FE's final exam took place immediately after the end of the experiment. This also allowed the author enough time to evaluate the subgroups' quality of work and identify those with special features for the interview. The semi-structured interview consisted of four open-ended prompt questions for each instruction group (see Appendix B). First, the interviewees evaluated the work produced by the other subgroups in their instruction group (either TG or CG). Later, the author returned the interviewees' own work and asked them to review and make comparisons between their own work and others'. All the interviews were audio-recorded and transcribed, and the extracts that exemplified this study's results were translated into English.

Procedure

All the participants took the IELTS Academic Reading test before instruction began. They were told explicitly that the experiment would help the instructor to clarify which reading instruction activity—English-Chinese translation or comics production—enhanced EFL reading comprehension to the largest extent and that in the future their lecturers would revise their teaching techniques accordingly. They were also reminded that the TG and CG instruction groups could not share their work with each other before the FE final exam because it would impact their performance on it, especially for the items measured in Unit 4-2 and Unit 5-2.

The experimental instructor and the participants met one day a week for two consecutive classes (100 minutes) during the normal class schedule. The order of the shared instruction and activities for Unit 4-2 and Unit 5-2 were counterbalanced for the two classes. That is to say, when one class had instruction in Unit 4-2 before Unit 5-2, the other class started with Unit 5-2 before moving on to Unit 4-2. All instruction and activities ended two weeks before the FE final exam. The RTF was administered without prior notice one week before the FE final exam. Immediately before the participants took the RTF, the instructor gave 85 minutes of supplementary English instruction that was unrelated to the content of Unit 4-2 and Unit 5-2. The participants took 10

minutes to complete the RTF. Selected participants also received a post-experiment interview after their FE final exam.

Analysis

SPSS 18 was used to compute all the statistical analysis in this study. The following are the qualitative analyses of the interviews and the participants' work.

Focus Group Interview

The researcher and a trained retired English teacher adopted thematic analysis to analyze the interview data. First, they independently read through and familiarized themselves with all the interview transcripts, writing down potential codes with their respective definitions and example extracts in a list. Next, they discussed their respective preliminary analysis and decided which codes would remain and which needed to be revised or reanalyzed. After repeated discussions, reanalysis, and revisions, a table of coding categories was finally developed (see Appendix C). The two coders then separately coded the entire interview data with an inter-coder agreement of 92%. Differences were resolved following a discussion between the two coders. Afterwards, the coded interview data was reviewed to look for and note themes and relations among the codes. In regular meetings, the two coders discussed their interpretations of the themes and relations that emerged in the codes and their respective data extracts. Between the regular meetings, they recursively compared their tentative themes across different data extracts until they were certain that the results were reliable and valid.

Quality of Translations and Comics

To begin the quality evaluation of the participants' work, the author and the trained retired English teacher developed a list of the referents and affordances mentioned explicitly in each sentence in the two chosen articles. The list supported the two evaluators in examining the accuracy of the students' work in the following quality grading process. After collecting all of the submissions from both groups, the two evaluators worked together to sort each type based roughly on the overall quality of each subgroup's work for each chosen article. Then, they conducted a detailed comparison within and between subgroups, followed by a comparison across instruction groups, to identify the key features of the submissions. After undergoing several rounds of discussion and revision, the two evaluators developed a grading rubric consisting of four descriptors reflecting the quality of meaning represented across the two types of submissions for the two articles, as follows:

- 1 – Everything mentioned in the text was presented, but some of the relations among those presented were not depicted or illustrated clearly.
- 2 – Everything was correct and relations were presented clearly.
- 3 – Everything was correct and the readers added something relevant to the content that was not mentioned explicitly in the text.
- 4 – In addition to descriptor 3, the content was presented in a coherently integrated way.

The descriptors were used to evaluate the content of each translated sentence or comic panel individually, and not applied to the overall quality of a subgroup's work for an entire article. The average inter-evaluator agreement on quality for 25% of the randomly sampled works ranged from 81 to 94%. Disagreements were resolved after discussion. The rest of the submissions were evaluated by the author alone.

Results & Discussion

Quality of Each Instruction Group's Work

TG. All the TG subgroups presented their translations in a sentence-by-sentence fashion (i.e., one English sentence in the chosen article followed by the Chinese translation of the sentence). The lowest quality of the TG's submissions began at the descriptor 1 level and was based solely on word-to-word translations (see Translation 1 below). Only one or two sentences in each passage were at level 1, and only two TG subgroups had this problem. The majority of the TG's translations were at level 2 (see Translation 2 below). None of their translations reached level 3 or 4.

“雅妮有一個名聲是一個很安靜的人” (Translation 1, TG E)

“*Yani had a reputation as a very quiet person*” (Anderson, 2013, p.55)

經過腦子掃描，醫生開始了解回聲定位的現象。

掃描秀出瞎子聽到回聲，大腦中有關視力的部分被刺激。 (Translation 2, TG F)

It was through brain scans that doctors began to understand the phenomenon of echolocation. The scans show that when a blind person hears an echo, the parts of the brain that are related to vision are stimulated (Anderson, 2013, p.65).

CG. The number of comic panels that each CG subgroup produced to present the content of the given article differed from one CG subgroup to another (Unit 4-2: 16 to 22 panels; Unit 5-2: 11 to 15 panels). Around one half of the panels in the comic strips produced for Unit 4-2 and one third of the panels produced for Unit 5-2 presented content that directly corresponded to one sentence from the text (see Figure 1 below). The rest of the comic panels combined the content of two to four adjacent sentences, which were sometimes integrated with relevant information that was not in the local (i.e., previous or next) paragraph (see Figure 2 below).



Figure 1. CG group sample 1.

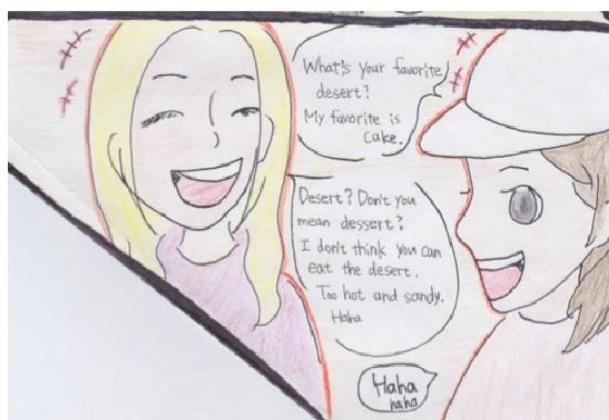


Figure 2. CG group sample 2.

A majority of the content in a single comic panel displayed descriptor 3 quality (see Figure 1). Only one CG subgroup produced problematic panels, with three panels in Unit 4-2 and two panels in Unit 5-2 evaluated at descriptor level 1. During the interview, the individual in this subgroup who produced the problematic comic panels clarified that these were due to his poor drawing skills and explained what he intended to display in his drawing (see Figure 3 below). The rest were at descriptor level 4 (see Figures 2 above and 4 below).

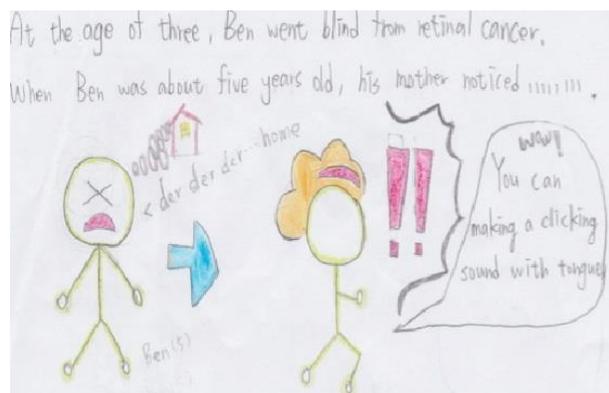


Figure 3. CG group sample 3.



Figure 4. CG group sample 4.

Comparison Between the Two Instruction Group's Reading Comprehension Tests

An independent-sample t-test was conducted to compare the two instruction groups' performances on the RTF. The results indicated that the CG's performance on the RTF was significantly superior to that of the TG's, $t(69) = 5.77, p = .000, d = 1.39, 95\% \text{ CI} [3.26, 1.58]$ (CG: $M = 9.23, SD = 1.73$; TG: $M = 6.81, SD = 1.80$). The effect size Cohen's $d (> .08)$ indicated that producing comics was a practical reading instruction activity that enhanced low-proficiency EFL readers' comprehension.

Interviews

The analysis of the post-experiment focus group interviews discerned 12 key aspects involved in producing the comics and two key aspects in the translations (see Appendix C for further description of these aspects). Moreover, three themes were identified in each instruction activity, revealing the respective influence of translation and comics production activities on EFL reading comprehension. Extracts from the interviews and the participants' comics and translations support the following explanations of the themes.

Themes in the comics production activity. After examining the other CG subgroups' comics, all of the CG interviewees responded that the content of the other CG subgroups' comics corresponded to the content of the articles, just as their own comics did; however, they all found the content of the others' comics to be slightly mismatched to their understanding of the text's content and how it should be presented. The following shows two of the CG subgroups' responses.

a1: *I think they were all correct, but they just seem...*

a6: *...our Brittany was discouraged! It's Yani who won the championship.*

a3: *At least they could draw her face without any facial expression to show she lost. I don't know why their Brittany laughed. She was Yani's opponent!*

a4: *However, their coach was drawn like ours, with wrinkles to show he's experienced!...*

a5: *and Yani's dad looks a bit like a bookworm. The text mentioned he is a golfer too. I never saw a professional golfer wear eyeglasses, but theirs does!*

(Extract 1, CG A)

b1: *We never thought that there could be a discussion (the final 4 sentences in paragraph 2 in Unit 5-2) between the doctor and Ben's mother in the clinic for the results of Ben's listening test. We thought that they (the sentences) could be the doctor's inner voice questioning the test results, so we drew the doctor as pondering the test results...*

b3: *...like our Ben wearing sunglasses to cover his eyes, that's what we usually see on the streets, but their Ben, his eyes were white!*

b2: *But I think it's just another way to show visual-impairment.*

b5: *it's like we argued the best way to show "confirm" (paragraph 3). I insisted "check the box" and you (b6) said an "ok" gesture but b4, you explained it's better to draw a doctor knocking a tuning fork and no special response...*

b6: *Then we realized we neglected the environment (circumstance), it is the normal but not the sharp sense of hearing that doctors proved Ben had...*

b4: *Exactly! This (sub)group didn't miss any textual content, they just presented it differently from ours.*

(Extract 2, CG B)

The differences in the ways that the CG subgroups illustrated the same text can be said to stem from the CG participants' contemplation of their personal experiences. For instance, in CG

subgroup C, the members who provided the idea of the mother-doctor discussion mentioned in extract 2 (see Figure 4 for the panel in question) said:

c4: *...what a mother would do taking her children to the clinic...my mother wouldn't...I mean, Ben's mother would be persistent in finding out the reason, just like my mom did, asking the doctor why I kept coughing one winter...then I thought, what would Ben's mother ask in the clinic, how would the doctor respond...?*

c5: *I believe it was his mother who asked the doctors to examine Ben's hearing, so the clinic interaction is perfect for them all. If we illustrated and arranged this part of the text contents like the paragraph's original arrangement, the scenes shown between the comic panels for this paragraph would be disconnected; when the other (sub)groups read our comics, they would feel awkward!*

(Extract 3, CG C)

Extract 3 shows that when members of CG C contemplated specific parts of the text, their relevant personal experiences gave clues to the potential situation the characters were engaged in and directed them to integrate those distinct parts of the text. In brief, content integration for specific parts of the text followed when the CG participants *fit a potential situation* to that part of the text. CG D's interview also revealed the same phenomenon, and in their case they even combined cross-paragraph information (see its corresponding comic illustration in Figure 2).

d1: *...she was struggling to talk to other golfers because her English was poor. I'm afraid of speaking English to Americans, we all have that problem. And here (pointing to the final paragraph in the article) she encouraged other (English) learners to keep talking. Then you can learn (English) even if you make mistakes. It means that she is not afraid of losing face. That's why here (pointing back to the previous paragraph for the sentences' contents in the questions shown for Figure 2) she can joke with other people now and have a big smile.*

d2: *...but her (Yani) smile might be a way to hide her awkward English mistakes, just like I did!*

d3: *But foreigners might treat it as she has sense of humor...my mother told me a hilarious dessert-desert example, then we added it to the dialogue...*

(Extract 4, CG D)

In the above four extracts, students also demonstrate that when they associated the text's content with their comic's illustrations, the CG participants were *echoing* what the characters experienced, for example the emotions in Extracts 1 and 4, the doctor's pondering in Extract 2, and the mother-doctor interaction in Extract 3. This is also why students drew the action of skateboarding in Figure 1, the blonde interlocutor's emotion of amusement in Figure 2, and the sound effect shown as a musical note in Figure 6. Although contemplation of their personal experience sometimes resulted in different illustrations for the same text, different personal experiences also led to shared perspectives of the same text. For instance, all of the CG subgroups drew Yani as crying with downward lips and shoulders (see Figure 5 below) to illustrate that she was unconfident the first time she left home for an international competition.



Figure 5. CG group sample 5.

The following extracts show two CG subgroups' explanations for what motivated them to create such an image:

a3: *...if I was alone, left my home to go to another country for an international game, I would have to take an airplane (to the international competition)!...in a strange place..., I definitely would miss my home.... I left home to attend university. I miss home too...I feel sad.*

(Extract 5, CG A)

b1: *I was hesitant before the Olympic math test, especially when I was in the training program. For this program, I left home and stayed at my uncle's home. I still felt homesick and cried.*

(Extract 6, CG B)

However, even if they were provided with the same background knowledge (e.g., the brain scan video in Unit 5-2), some cases showed that the CG participants' personal experiences, when relevant to the textual content, dominated the way they illustrated the text, as shown in Figures 6 and 7 below. Both students illustrated that the doctor used another way to examine Ben's special skill after the original listening test method failed to explain the skill. The illustration in Figure 6 was explained in Extract 7 below:

c2: *I received a brain experiment once, and the scanner here (in Figure 6) was the type of scanner that the experiment used, but I slightly changed its look and made it more futuristic, like the one I recently saw in a sci-fi film.*

(Extract 7, CG C)

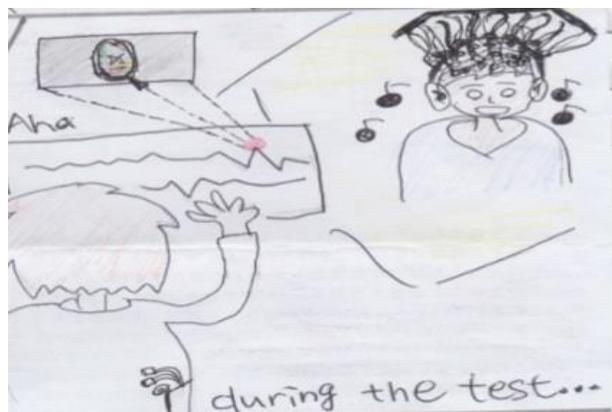


Figure 6. CG group sample 6.

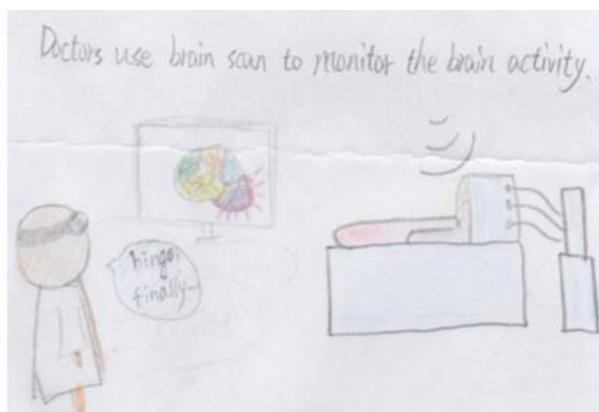


Figure 7. CG group sample 7.

Altogether, similarities and differences between the illustrations for the same texts across subgroups revealed how individual members' own experiences often influenced their drawings; the comic illustrations that CG participants displayed corresponded not only to the textual content but also to their own reflections or self-images. Thus, the content that each subgroup's comic strip presented was not simply an illustration of the original text but instead became infused with the participants' own stories—that is, their life stories and experiences as readers and as individuals. In short, they *produced meaning belonging to themselves as readers*.

Overall, three major conclusions can be drawn from the themes in the comics production activity. First, producing comics ensured the readers constructed specified mental entities for the individuals and objects mentioned in the texts. Extracts 1 and 2 show that the CG participants specified the entities based on both the features mentioned in the text (e.g., a5) as well as on the participants' general knowledge (e.g., a4, b3). That these entities were consistently specified in the readers' mental representations was particularly obvious when looking at how the entities were represented in their comics. For example, to illustrate that it was Yani's first time leaving home to attend a global golf competition, CG D drew a girl with a white hat (see Figure 5) and a house with a red roof as referents of Yani and Yani's home, respectively. Later, to illustrate that Yani in the next paragraph was described and recognized by the public as optimistic and humorous (see Figure 2), CG D drew two entities. Viewers could easily recognize which one was Yani because of the consistency of the physical features shown in the two figures, although the two panels were sketched by different members of the same subgroup. Altogether, in order to produce comics for what they read, the specified representations of the entities that were formulated by readers when drawing promoted indexing processes, in line with Glenberg's et al. (2004) finding that an embodied approach encourages indexing. In particular, the connection of words and their corresponding referents was consistent throughout the comic panels produced by a given subgroup, indicating that indexing also carried over across paragraphs (e.g., Yani in figure 2 and 5).

Second, all the entities mentioned in the texts came alive in the comics. As displayed in every figure, affordances were drawn as stated by the text (e.g., Figures 6, 7: the doctor evaluated brain scans). If indexing fails, readers cannot derive proper affordance or manipulation of a referent (Glenberg & Robertson, 2000). Moreover, these affordances were meshed according to the syntax of a sentence (Kaschak & Glenberg, 2000); that is why it is Yani and not the blonde

character in Figure 2 who told a joke. The blonde interlocutor was an experiencer who merely gave responses because Yani was the main agent in the sentence. Overall, the CG group's superior reading comprehension is consistent with Borghi's (2004) findings that reading comprehension is constrained by entities' affordances.

Additionally, the CG participants were immersed in the text's content. Actions, perceptions, and introspections that were not mentioned in the texts but were relevant to the text's content were revealed in their comics (e.g., Figure 6 and 7: the tongue-clicking sound effect; Extract 1-a6, a3: feeling discouraged). In short, they were not confined by what the texts explicitly depicted and mentally simulated laughing, crying, and other actions or emotions relevant to the situation (e.g., how the characters might have expressed themselves and what proper affordances or interactions could happen among them). In other words, they made inferences to elaborate on and illustrate the text's content, making their corresponding illustrations more intelligible. Thus, their mental representations of the text's content, demonstrated externally by their comics, were as embodied and multimodal as the representations that proficient readers construct (Barsalou, 1999a; Zwaan & Brown, 1996). Moreover, by means of the activity, the CG participants synthesized the text's content. As Extract 2 showed, a potential situation was developed to fit and cover all the relevant textual content which was then synthesized into a coherently connected whole. Possible characters and interactions were evoked to further illustrate the textual content (see Figure 4), and simulations for the text's content arose accordingly (Barsalou, 2008; Zwaan & Taylor, 2006). Thus, in the present study, producing comics not only prompted the CG participants to contemplate situations relevant to the text's content in order to produce coherent comics, but also facilitated their reading comprehension of the text. Furthermore, because learners collaboratively produced the comics, they had the opportunity to discuss and be mindful of the differences among the illustrations drafted by group members, allowing them to discover where their own misplaced focus at the word-level and neglect of sentence-level contextual information may have led to inadequate comprehension of the situations being described (e.g., Extract 2: b5, b6). In essence, by means of producing comics, the representations that the CG participants constructed for what they read were embodied situation models. This resulted in better test performances compared to their TG counterparts because, in a similar vein with prior studies (e.g., Zwaan & Radvansky, 1998; Zwaan & Rapp, 2006), constructing embodied situation models facilitates comprehensive and in-depth reading comprehension.

Themes in the translation activity. The TG subgroups' interviews showed that the discussion of the appropriate translation for a piece of information in the article did not involve the discussion of the text's content as a whole. The following shows the examples given by two TG subgroups in the interview:

- e1: ... "Through" in "Through the brain scan" translated to "經過" sounds strange,
- e2: we argued about this problem in class...
- e3: ...we compared every word of our Chinese translation to an English sentence in the article,
- e2: and sometimes we consulted an online dictionary, like for "through". It can be "by means of" and "from the beginning to the end".
- e4: We know here it means "by means of" and "經過" has these two meanings as well,

e5: *but it also means “passing by” ...*

e2: *“by means of” is never the first one for “經過”; however, “by means of” is always the first meaning that comes to our mind for “透過”*

(Extract 8, TG E)

f1: *Struggle is a verb here (“she struggled to communicate with other golfers...”), but I don’t think I’ve ever heard it as a verb in Chinese...*

f5: *...we say “她很掙扎” (“she is very struggle”), no one says “她掙扎” (“she struggles to”)*

f4: *if we say “她掙扎的去溝通” (“she is struggle to communicate”), struggle is not a verb here, it’s ADJ! But still, rarely do Chinese say this, it just doesn’t feel right...*

f5: *...struggle is a noun in our translation (“她對於和其他球友交流感到掙扎”), but “對於” (“concerning”) and “感到” (she felt that...)... I think this translation is ok, but it is merely at the so-so level in Chinese.*

(Extracts 9, TG F)

These extracts show that the TG participants spent time *analyzing the two languages*, although they were also concerned about whether the translations were *faithful* to the original English sentences in the chosen articles and *smoothly* followed the rules of Chinese grammar. However, the TG participants struggled to *strike a balance between the two languages* when producing translations. In particular, no apparent signs of in-depth discussion for the text’s content emerged in their interviews, nor were there signs of students integrating meaning across sentences. Although translation is recognized as facilitating low-proficiency EFL readers in comprehending what they read (Lin & Yu, 2013), the TG participants’ interviews indicated that the translation activity did not allow for low-proficiency EFL readers to actively simulate and immerse in the situations explicitly or implicitly depicted in the texts. This instead encouraged relatively superficial processing, resulting in inferior reading comprehension compared to those practicing embodied comics production. This finding is in accordance with Zwaan and Brown’s (1996) study that low-proficiency readers do not simulate and construct multimodal representations automatically for any given text they read. Without proper support for these readers to construct embodied representations of the texts and to simulate situations that the texts describe, the texts are less likely to be understood comprehensively (Glenberg, 2007).

Conclusion and Implications

The present study demonstrates that the entire comics production process undertaken by the low-proficiency EFL learners was an embodied experience. After the low-proficiency EFL learners engaged in the comics production activity, they had better reading comprehension than those involved in the translation activity. However, the embodied process of discussing while drafting the comics as experienced by the CG likely entails more learner interactions in comparison with TG’s experience discussing to draft a translation. Thus, CG’s superior reading performances might be also attributed to the amount of learner interaction. This study also implies that EFL learners, when instructed with appropriate reading activities, can overcome the limitations of

gaps in foreign language proficiency by elaborating and generating inferences for the English texts they read. Therefore, apart from focusing on the instruction of low level processing skills, reading teachers could use an embodied post-reading activity to promote high-level processing skills (i.e., constructing situation models and making inferences) for low-proficiency EFL learners. Future research should focus on whether low-proficiency EFL adult learners, after receiving long-term training in embodied post-reading activities, could automatically operate high level processing skills during EFL reading.

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Appendix A

True or False Reading Test

If the following statements agree with the information given in the two passages (Unit 4-2 and Unit 5-2), then write True; otherwise, write False.

- * Yani's amateur golf career took off after she won the Callaway Junior World Golf Championship.
- * Yani was named LPGA player of the year when she was 22 years old.
- * After Yani improved her English, she was able to confidently joke and chat with reporters and other golfers.

- * Brittany Lang beat Yani at the women's British Open in 2011.
- * Yani's parents encouraged her to play golf.
- * Annika Sorenstam said Yani is mentally strong and aggressive.
- * Doctors found that Ben had developed a sharper sense of hearing.
- * Ben went blind because of retinal cancer.
- * Doctors used brain scans to understand the phenomenon of echolocation.
- * Ben's mother noticed that the sounds made by Ben's tongue clicking allowed him to understand his environment.
- * However much he practiced, Ben couldn't skateboard around his neighborhood.
- * By using echolocation, when a blind person hears an echo, that echo is a stimulus to the hearing parts of the blind person's brain to analyze the shape and size of nearby objects.

Appendix B

Focus Group Interview Prompt Questions

CG:

- * After reading the other groups' comics, what do you think about their works?
Make comparisons between your and the other groups' comics.
- * How did you construct the corresponding drawing for the comic illustrating a given piece of information in the article? Give examples. How did you decide which member(s)' drawing was the ultimate comic illustration for that piece of information in the article? Give examples as well.
- * Which content in the article was the easiest/the most difficult to construct its' corresponding comic illustration?

TG:

- * After reading the other groups' translations, what do you think about their works?
Make comparisons between your and the other groups' translations.
- * How did you translate a given piece of information in the article to Chinese? Give examples. How did you decide which member(s)' translation was the ultimate translation of that piece of information?
Give examples as well.
- * Which content in the article was the easiest/the most difficult to translate into Chinese?

Appendix C

Coding categories

The first 12 categories are the key aspects involved in producing the comics and the final two are for producing the translations.

Codes	Description	Example
Audio	Using musical notes or linguistic symbols (e.g., clicks) to show sound effects.	(To show the blind person's echolocation skills) <i>his mouth open, showing he is making the sounds and a musical note around him to emphasize that the sound is coming out of his mouth...</i>

Visual	By means of online visual resources, participants visualize text contents.	<i>I thought that I knew what aggressive is, but actually not! I know the meaning of aggressive but when we tried to draw an aggressive golfer, we had no ideas for it. Then we Googled pictures for aggressive and checked YouTube for Yani and other golfers' LPGA videos....</i>
Background	Locations and settings.	<i>...lots of houses, trees, yards, and long pavement, no tall buildings. It's a typical American neighborhood I saw in the movies, and Ben rode his bike on the pavement in this neighborhood...</i>
Action	Movements and acts.	<i>His (Ben's) feet should be on the pedals and his hands on the handlebars to show that you're riding a bike...</i>
Character	Shaping characters.	<i>Ben's and normal people's eyes were all drawn in the shape of a circle, but the normal people's eyes were filled in with black color and Ben's were all white (to show that Ben's blind).</i>
Event	Occasions and circumstances.	<i>...Yani won the champion, so Callaway Junior World Golf was written on the banner of the championship award ceremony and Yani wore a gold medal...</i>
Inference	Those that were not mentioned in the text contents but were relevant to them.	<i>(As shown in the previous example) Yani wore a gold medal.</i>
Emotion	Using facial expressions, gestures, or punctuation marks (e.g., exclamation marks) to illustrate emotions.	<i>Ben passed away. It (the article) also mentioned sadness, so tears dropped from her (Ben's mother) face....</i>
Time	Showing a calendar, clock, figures on characters' T-shirts, relative sizes between characters and objects, or slight changes in the same characters' hairstyles to illustrate changes in time.	<i>When Yani was still a child, she wore a white hat and had two braids tied at the left and right sides of her head, but when she grew up, she had only one ponytail at the back but still wore a white hat, and her golf clubs became smaller as she grew up...</i>
Integration	When the two events mentioned in the chosen articles are (from the individual readers' perspective) related, the contents of the two events are illustrated within a single panel.	<i>Yani wanted to encourage girls to be golfers. Well, a lot of professional athletes say that in their fan-meeting press conferences. The author also said, not Yani herself, that she could be an inspiration to English learners, although</i>

		<i>she indeed studied English diligently; the author also quoted her English learning advice. I think this advice could be given at fan meetings as well, one single panel is enough to show them all...</i>
General knowledge	General knowledge.	<i>(Following the previous example) they are what professional athletes usually say in their fan-meeting press conferences apart from telling their fans and the press their training plans and goals for next season. Then what else would they say on that occasion?</i>
Personal experience	Individual readers' special experiences, which are different from the information mentioned in the text.	<i>I wasn't lying in a brain scanner. I just sat and they put a strange helmet on my head.</i>
Wording	Clarifying common Chinese wordings and their English equivalents	<i>Mentally in Chinese, it can be “精神”, “智能”, or “心理”. Here, it says Yani is “mentally strong” but in Chinese, we never say “精神/智能/心理 強健”. We tried online translators to help us solve this problem, but the result was even worse....</i>
Syntax	Clarifying the differences between English grammar and Chinese grammar	<i>We do have “被”... (“passive voice”), like “he was beaten by his girlfriend”, but it feels weird when we translate it (“echolocation is used by animals...”) to Chinese: “回聲定位被有敏銳聽覺的動物使用來怎樣怎樣”; in Chinese, we can understand the meaning of this translation. In Chinese, when we say, “the animals do blah blah blah, something is used by human beings”, that is more sensible.</i>

About the Author

Ruei-Fang Shiang is a PhD student in TESOL at National Taiwan Normal University. Her research interests include reading, pronunciation, and neurocognitive aspects of language teaching and learning. E-mail: joyceshiang@yahoo.co.uk