Embodied Experiences in Second Language Learning of English Modal Verbs

Sakol Suethanapornkul
Chulalongkorn University

1. Introduction

One great debate in cognitive science rests upon the role of bodily experiences in information processing and knowledge representation, that is whether a human body provides the ground from which a higher form of human cognition arises. A longstanding view (e.g., Neisser, 1967) holds that mental representation is symbolic and abstract and that the human body is peripheral to an understanding of the nature of cognition. According to this view, once sensory inputs—linguistic, perceptual, olfactory, etc.—pass through a stage-based, feed-forward, modality-specific system, they are instantiated as abstract concepts in a processing unit, without traces of perceptual information or associative motor response (Barsalou, 2009). For example, a concept of DOG is simply registered as [CANINE, FOUR-LEGGED] independent of human subjective experiences and events in which we play with a dog or touch its fluffy hair (Gibbs, 2005, chapter 4; see also Croft & Cruse, 2004).

In recent years, however, this so-called disembodied cognition thesis has come under intense scrutiny. Empirical evidence from psychology, linguistics, and cognitive science converges to suggest that human cognition is grounded (Robbins & Aydede, 2009). Chief among many claims of grounded cognition is the thesis that the human physical body and its interaction with the world ground human cognitive processes (Gibbs, 2005; see also Wilson, 2002). As a result, human conceptual knowledge is perceptual (Barsalou, 1999, 2008). In a concept formation process, an entity (i.e., object, event, or concept) is perceived and stored as a modality-specific perceptual symbol, in a form of an associative pattern of neural activation (see also Spivey, 2007). Presumably when a child first learns a concept of "chair," for example, she begins to associate a chair with the affordances it provides (e.g., a surface to sit on), the haptic experience of rocking a chair, and so on. The perceptual states in the sensory-motor systems recruited during the interaction with the chair are stored in the perceptual symbol "chair." Multiple instances of the same perceptual symbol are linked together under a frame (i.e., a schematic referent of an entity.) The frame is then tied to a background concept (chair-furniture) (see Croft & Cruse, 2004 for a similar discussion of a profile-base relationship in Cognitive Linguistics). Over the course of childhood, language develops in conjunction with perceptual symbols (Smith & Gasser, 2005) and is used to index frames. When a perceptual symbol is retrieved, the brain performs a simulation, recruiting various sources of information from our bodily interaction with the environment (Barsalou, 2008).

Much research has offered empirical evidence of bodily grounding of human cognitive processes. For example, participants were faster to evaluate a concept (e.g., LOVE or HATE) when it corresponded to the action participants performed (i.e., pulling or pushing a lever) (Chen & Bargh, 1999). In addition, handedness affected participants' judgments. If right-handed, they regarded objects on their right as better than those on the left. Nonetheless, this effect was reversed when right-handed participants were trained to use their left hand (Casasanto & Chrysikou, 2011). A heavy object induced participants to perceive issues in front of them as highly important (Jostmann, Lakens, & Schubert, 2009). In a similar vein, wearing a white lab coat—associated with being attentive and careful—can enhance performance on sustained and selective attention tasks (Adam & Galinsky, 2012). Results

* This research was supported by the Chulalongkorn University Language Institute (CULI) Research Grant. I am indebted to Dr. Supanee Chinnawongs, Chariya Prapobratanakul, and Michael Alroe for their feedback on the early drafts of this paper. I am also grateful for the insightful comments from the two anonymous reviewers.

from neuroimaging studies have corroborated behavioral studies: our own bodily states ground not only our actions but also other people's. The mirror neuron system in the parieto-frontal cortical circuit responsible for finger movements discharges even when we passively observe other people performing grasping actions (Iacoboni, et al., 2005; see also Iacoboni, 2009).

The cursory review above may attest to the fact that embodiment is pervasive across myriad aspects of the human cognition, none more so than language. Eye movement is used to index spatial information during a language comprehension task (Spivey & Geng, 2001). Likewise, motor control is recruited, and perceptual information (e.g., object orientation) activated to aid sentence comprehension (Onnis, Jackson, & Spivey, 2010; Stanfield & Zwaan, 2001; Taylor & Zwaan, 2009; Zwaan & Madden, 2005). Given the current state of research, one might wonder why embodiment is in play during cognitive processing of such an abstract concept as language. One plausible hypothesis is that certain parts of the human linguistic system rely on concrete, physiological experiences with the environment. The mapping between the two separate domains is done through a conceptual metaphor (Lakoff & Johnson, 1980). The environment offers affordances for human bodies to experience gravity, force dynamics, and so forth, and through grounded interactions human beings extend basic image schemas of tacit, kinesthetic, world experiences (UP, DOWN, STANDING UPRIGHT) to many abstract linguistic constructions (Croft & Cruse, 2004; Lakoff & Johnson, 1999). Another explanation is that there is a tight coupling between perceptual and linguistic systems. Language comprehension is an embodied process whereby a listener mentally simulates an event she hears (MacWhinney, 1999, 2008). Upon hearing a sentence such as "I threw the bottle into the trash bin," the listener assumes the perspective of an agent performing an action (e.g., throwing the bottle). This mechanism of perspective taking allows a child to map a basic argument structure with grammatical categories (agent-subject and action-verb). Grammar then emerges from embodiment (MacWhinney, 1999).

If it is the case that physiological experiences ground language, one may assume learning a language is learning to establish an integrated frame of constructions—the pairing between linguistic constructions and grounded experiences—such that learners can simulate a sequence of action packaged in the constructions (Barsalou, 1999).

This research tested if providing second language (L2) users with an integrated frame of construction would aid L2 constructional learning. To do so, this study looked at an English modal construction which, as Talmy (1988) and Sweetser (1990) argue, is structured from physical force. According to Talmy (2000), a semantic structure of English modals is subsumed under Force Dynamics, which encompasses such notions as force exertion, force resistance, the overcoming of a resistance, and so forth. The English modal construction is complex with different granularities of force dynamics at play, providing an optimal opportunity to test the role of embodiment in language learning. In her analysis of English modals, Sweetser (1990, chapter 3) maps each modal verb with its corresponding force dynamic scenario. For instance, we feel driven by either a strong external or internal force to perform an action (*must*). Sometimes, we are barred from performing an action and only when someone steps in and opens the door of opportunity for us has the action been realized (*may*) (see also Talmy, 1988). Also, we know that we are capable of performing an action when we see ourselves carrying out such thing (*can*). In addition, Sweetser argues that root meaning is mapped onto epistemic modality which denotes necessity, probability, or possibility in reasoning. Thus, a statement "*I'm certain he must be in bed by now*" implies that a speaker is compelled by all available information to reach this, but not any other, conclusion.

This grounding of modal verbs on force dynamics bears not only theoretical importance to research in embodied cognition but also practical applications to L2 instruction. Research has documented that a majority of L2 users fail to become fully competent in their L2 and their grammatical end-states are incomplete (Ellis, 2008). Modal verbs remain one of the most difficult constructions for L2 users to learn, and teachers admit the construction is difficult to teach (Celce-Murcia & Larsen-Freeman, 1999). The inherent difficulty may be explained by the fact that most, if not all, English language teaching (ELT) textbooks explain English modals in terms of speech act functions they perform (e.g., *may* for giving or requesting permission) (See Tyler, 2008 for a review of English modals in ELT textbooks). Some functions are expressed in several modal verbs, posing a challenge to L2 users. Furthermore, a speech act description often fails to discern subtle differences between modals (e.g., *You may leave the room* and *You can leave the room*.) Force dynamics, on the contrary, offers a simpler, more intuitive description of English modals. Because force dynamics is part and parcel of English modals, language instruction should seek to integrate such embodied grounding into a constructional frame to allow L2 users to develop a native-like understanding of the construction. This is the point the present study addressed.

This study tested whether L2 users who learned to associate force dynamics with modal verbs (i.e., embodied group) would perform better than those who studied speech act functions of modals (i.e., non-embodied group). While cognitive linguistic analysis has informed L2 education in many areas (e.g., Boers & Lindstromberg, 2008; Tyler & Evans, 2003), research that utilizes the force dynamics description to teach English modals is rare, perhaps due to the scale and complexity of the construction. The dearth of evidence prompted L2 researchers to explore the efficacy of embodied account of English modals with respect to the speech act description. One previous study has already made this comparison (Tyler, Mueller, & Ho, 2010; see also Tyler, 2012, chapter 4), and a few other studies have looked at embodied descriptions of modal verbs as a byproduct of research with a different focus (i.e., individualized feedback on L2 users' legal writing) (Abbuhl, 2005; see also Tyler, 2008). But none of the previous studies have made a systematically controlled experiment involving embodied learning of modal verbs. In Tyler et al. (2010), although participants in a cognitive linguistic group performed slightly better than those in speech-act group, results were confounded by multiple factors, one of which was teacher intervention. This study therefore employed a randomized, experimental control to test whether participants exposed to embodied grounding of English modal verbs would learn better than those in non-embodied group.

2. Method

2.1. Participants

Participants were 43 (23 female and 20 male) Thai native-speaking college freshmen at Chulalongkorn University in Bangkok, Thailand. At the time of the experiment, they were taking a second mandatory Foundation English course offered by the Language Institute. Participants, most of whom were taking an English class taught by the researcher, came from three different faculties (i.e., Pharmaceutical Science, Engineering, and Law). On average, they had studied English for 13.82 years (*SD* = 2.07, Min-Max = 10-19). On a scale from 1 (lowest) to 10 (highest), participants rated their English abilities at an average of 5.35 (*SD* = 1.21, Min-Max = 3-8). Participants were randomly assigned to one of the two conditions: Embodied (n = 21) and Non-embodied (n = 21). In addition, 17 participants who were college freshmen in the Faculty of Dentistry were recruited to act as a baseline control group. They all gave informed consent before participating in the experiment.

2.2. Materials

For the training phase, two computer modules were developed: a force dynamics "game" and a speech act self-instruction program for embodied and non-embodied conditions, respectively. With six target modal verbs (*must*, *have to*, *will*, *would*, *may*, and *might*) and *should* as filler, the present work focused on both root ("*You must write this book*") and epistemic ("*She must be in bed by now*") meanings in order to provide as complete a semantic system of English modals as possible, while highlighting conceptual differences between root and epistemic meanings (see Radden & Dirven, 2007 for further discussion). Nonetheless, the decision was made not to include every aspect of English modals in the materials. More specifically, the conditional meaning (e.g., "*I would leave when John came*") of distal root and epistemic modal verbs were excluded mainly because firstly, it required a different scenario to be set up in the embodied game (see below), and secondly the inclusion would have increased an average number of words in sentence prompts, making it impossible to control for sentence length.

2.2.1. The force dynamics game

The game served to profile the embodied nature of English modals. It presented participants with a scenario of hand-drawn cartoon characters and objects in black and white, accompanied by a sentence prompt at the bottom. Participants were instructed to perform an action that each sentence prompt profiles by dragging one character (trajector) to push or support the other (landmark) to act on an object (e.g., *"You must call the hotel"*, *"You should watch this movie"*, etc.) When the action was complete, the “next” button appeared on the lower right side. Participants clicked on the button to move on to the next scenario. In every scenario, there were always two cartoon characters on the left side of the screen, standing side by side, and the object to be manipulated on the right side (see Figure 1). For epistemic scenarios, the leftmost character was replaced by a magnifying glass signifying evidence. The glass then became a trajector exerting force on the character (see Figure 2).

For each modal verb, ten root and five epistemic scenarios were constructed. There were, however, only ten root scenarios for *should*. The reason for the omission of epistemic *should* was largely due to the fact that it would be very rare, although possible in some dialects, that *should* would be interpreted exclusively in an epistemic sense (Radden & Dirven, 2007). In total, there were 100 scenarios, each of which was paired with its sentence prompts. Prompts were controlled for word frequency and length. Word frequency was extracted from American National Corpus (ANC) and West’s (1953) General Service List (GSL), (http://jbauman.com/aboutgsl.html). For root sentence prompts, ten highly frequent verbs and nouns, each of which appeared more than 1,000 and 100 times in ANC and GSL respectively, were selected. Each verb was paired with one noun, and thus there were ten verb-noun pairs, all of which were combined with every modal verb. No attempt was made to control for the frequency of each verb-noun pair. All root prompts shared the same type of construction. On average, the prompts contained 5.1 words (Min-Max = 4-6).

In addition, epistemic sentence prompts contained five frequently used phrases (i.e., *be late*, *be in bed*, *be home*, *be at the party*, and *be very happy*). Each prompt started with “*I think*” to denote necessity, probability, or possibility in reasoning. On average, the prompts contained 7.2 words (Min-Max = 6-9). All scenarios were randomized across participants, and participants were trained to play the game with an unrelated modal verb (i.e., *can*). A sample of sentence prompts is provided in the Appendix.

2.2.2. Speech act self-instruction program

The program presented each modal verb separately along with its speech act functions (e.g., permission, obligation, necessity, etc.) and sample sentences. These functions were taken from ELT textbooks and teachers’ grammar books (e.g., Celce-Murcia & Larsen-Freeman, 1999). The program allowed participants to navigate through a list of modal verbs in any order they wished. In addition, there were three communicative exercises and two wrap-up activities that allowed participants to practice using English modals in different contexts (see Figure 3). The program was designed such that participants had to study every modal verb and complete all the exercises and activities, albeit in random order, otherwise the program would not terminate. Sample sentences of each modal were taken from sentence prompts in the force dynamics game to make sure participants were exposed to the same inputs. However, word frequency and sentence length in communicative exercises and wrap-up activities were not controlled.

2.2.3. Modal verb test

A multiple-choice modal verb test was developed to test the efficacy of embodied learning of English modals. Six questions were created for each modal verb, three for root and three for epistemic modality, with additional four *should* questions as fillers. Altogether there were 40 questions. However, participants’ answers on the filler items were not recorded, thus yielding a maximum score of 36. Each question presented a sentence- or a paragraph-level context where a modal verb was missing (see Table 1). Participants were instructed to read each question and choose the most appropriate answer from the four possible choices. The test was pilot tested with two native speakers of English and revised until they both agreed on the same answers. With 100% rater agreement, the test was then piloted with a group of college freshmen who were blind to the purpose of the test. Overall, Cronbach’s alpha reliability coefficient index was 0.82, indicating good internal consistency for the test. All of the test questions were then randomized to produce versions A and B. The test was blocked such that half of the participants received version A for their pre-test and version B for post-test and the other half, vice versa.

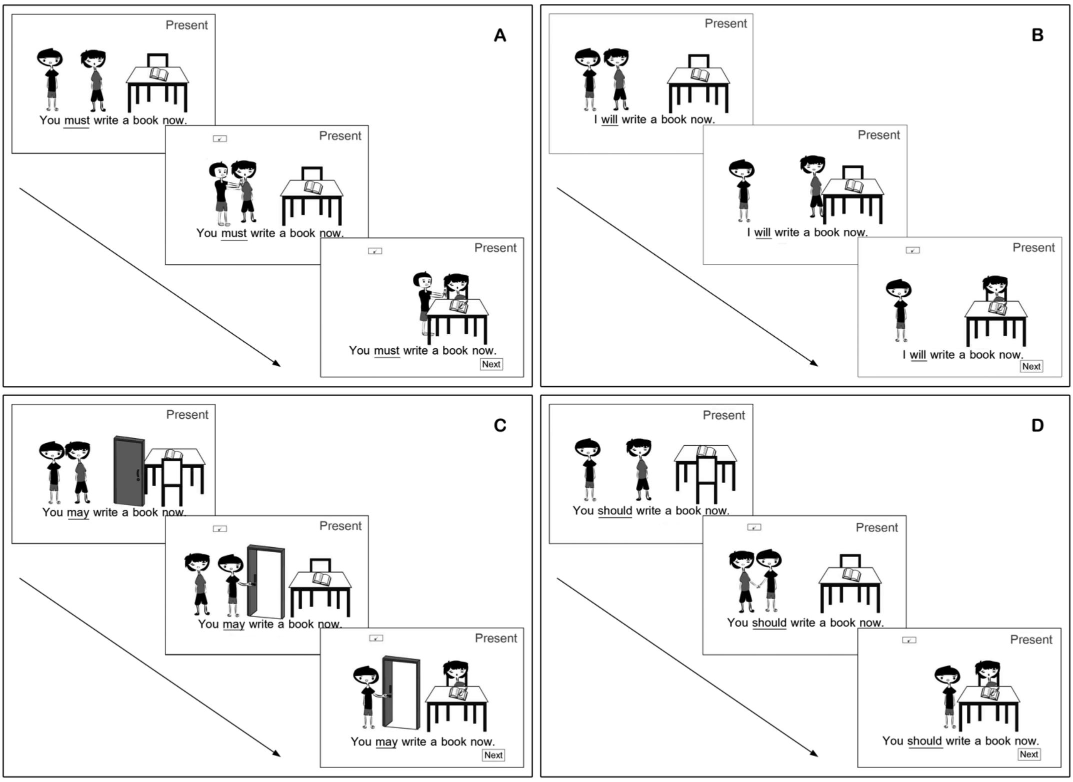

Figure 1. The game set-up for the root meaning in the force dynamics game. In Figure 1A, following the scenario "*You must write a book now*," participants performed two steps in the game: (a) dragging the leftmost character to (b) push the other character all the way to perform the action (i.e., write a book). In Figure 1B, to represent the volition of *will*, participants dragged the right character to perform the action, whereas in Figure 1C for *may*, the leftmost character opens the door and lets the second character pass through to perform the required action. For *should* in Figure 1D, the leftmost character holds hand with the other character, walking together to the table. Notice the gesture of the leftmost character: he is extending both hands to exert force in *must*, while standing idly by in other scenarios.

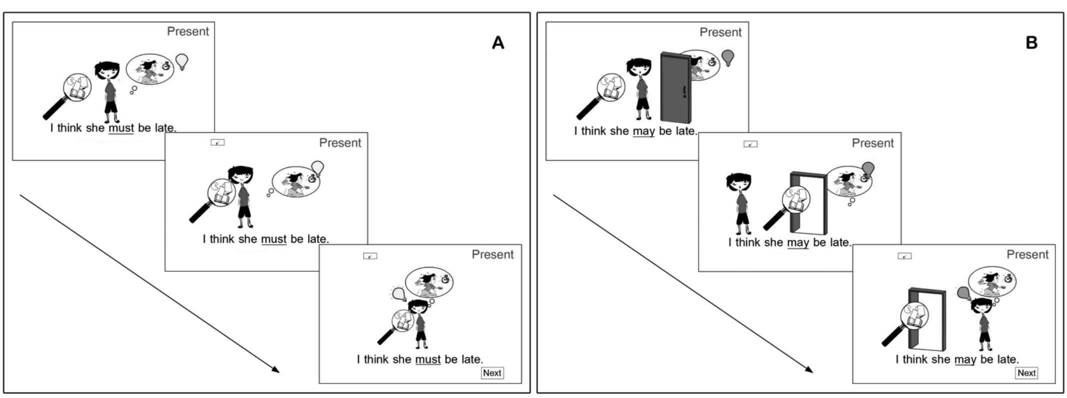

Figure 2. The game set-up for the epistemic meaning in the force dynamics game. The magnifying glass represents evidence, thus becoming an exerting force instead of the character. Participants dragged the glass to push the character to the idea bubble. The color of the light bulb represents the level of certainty in an epistemic assessment (see Radden & Dirven, 2007, pp.239-240).

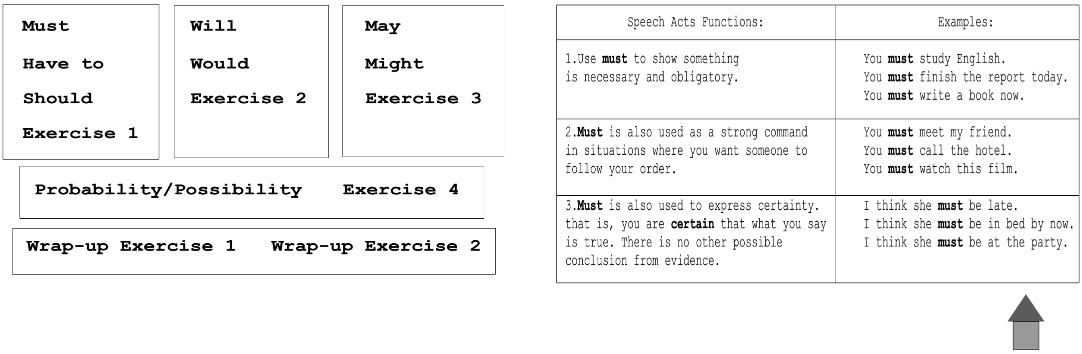

Figure 3. The screenshots of speech-act self instruction program for the non-embodied group. When participants clicked on one modal verb, they saw its functions and sample sentences. Participants then reviewed the mini-lesson by doing one of the exercises. When they were finished, they took the two wrap-up activities, and the program terminated.

Table 1
Modal Verb Test Sample Questions

Target Modals	Sample Questions
1. Must	
- Root	The water is rising very fast and now it's almost over the edge of the concrete wall. We absolutely _____ pack and move every electronic device to the second floor immediately. a. may b. must c. should d. would
- Epistemic	Jenny's engagement ring is enormous! Look at the huge diamond and all the smaller diamonds around it. It _____ have cost her fiancée a lot of money. a. might b. must c. should d. will
2. May	
- Root	The book is very old. My professor said we _____ open it to see the inside if we'd like, but we have to be careful not to damage it. a. may b. must c. will d. would
- Epistemic	I haven't seen him since Monday. There's no note or anything on his table. So I don't know exactly where he is right now. He _____ be on holiday. a. has to b. may c. should d. would

2.3. Design and procedure

Upon arriving at the lab, participants were informed that they were going to study English modals. After signing the consent form, they completed a pre-test and a 15-item cloze test (Bachman, 1985) and wrote down basic information (e.g., Faculty and English grade) on the form provided. Seven days later, they returned to the lab and were seated in a quiet booth equipped with a Windows-operated PC. During the training phase, they were instructed to pay attention to the program they were about to study and to ask for help, if any was needed, from the researcher. Also, participants were allowed to take notes on the sheets of paper, but the notes were taken away once participants completed the training phase. In the embodied condition, participants played the force dynamics game in which they had to manipulate characters according to the sentence prompts while participants in the other group studied a set of modal verbs along with their speech act functions and did review exercises. After the participants finished studying, they took the immediate post-test. Finally, participants completed a Language Experience and Proficiency Questionnaire (LEAP-Q) (Marian, Blumenfeld &

Kaushanskaya, 2007) which was translated into Thai. They were compensated for their participation and dismissed.

2.4. Data analysis

Participants with pre- or post-test scores beyond ±2 standard deviations from their group mean were considered outliers and omitted from the analysis. In the end, one response from the non-embodied group (x_{pre} = 33 and x_{post} = 33 out of 36) was excluded from the analysis. The data from the rest of the participants (n = 59) were aggregated. In addition, gain scores[1] were computed by subtracting participants' pre-test from their post-test scores. A positive gain score meant that a participant performed better on his/her post-test than pre-test, while a negative score meant the opposite. The mean gain scores of the three groups were subjected to a one-way ANOVA test, with groups as a between-group factor.

3. Results

3.1. Cloze test

Participants' global English proficiency was measured using an adapted version of Bachman's (1985) cloze test, with a maximum score of 15. Participants in the embodied group (M = 6.33, SD = 2.20) performed only slightly better than their counterparts (M = 6.29, SD = 2.69); however, there was no significant difference between the two groups, $t(40) = 0.06$, $p = 0.950$, 95% CIs = [-1.49,1.58], Cohen's $d = 0.02$. The two groups, therefore, were on equal footing in terms of their language proficiency.

3.2. Statistical analysis of the test scores

This research asked whether L2 users in the embodied condition who studied the force dynamics of English modals would exhibit any significant differences from their counterparts in the non-embodied group who studied English modals along with their speech act functions. As shown in Table 2, both groups showed, on average, a 3-point gain from their modal verb pre-test to post-test scores. For the post-test, the embodied group performed slightly better than the non-embodied group, who in turn were marginally better than the baseline group (see Table 2). Note that, in Figure 4, while participants in both embodied and non-embodied conditions showed some improvement, their average test scores were still well below the maximum scores of 36. Participants in the baseline condition did not show any gains, thus ruling out the possibility that learning might have occurred from simply taking the test twice.

The one-way ANOVA, $F(2, 56) = 6.10$, $p = 0.004$, $\eta^2 = 0.22$, demonstrated statistically significant differences between the three groups. A post-hoc comparison using Tukey's HSD indicated that the embodied and non-embodied conditions did not differ from each other (Mean difference = 0.14, p = 0.98, Cohen's d = 0.05). However, both groups showed a significant difference from the baseline group (embodied-baseline [Mean difference = 2.75 p = 0.007, Cohen's d = 1.25] and non-embodied-baseline [Mean difference = 2.61, p = 0.011, Cohen's d = 0.87], respectively). Figure 5 confirms the ANOVA test in that the mean gain scores of the embodied and non-embodied conditions did not overlap with those of the baseline group. Notice, also, that the SD of the embodied condition—as opposed to the other two groups—was relatively small, suggesting that as a group, participants performed similarly. The SD of the two groups, on the contrary, encompassed a wider range of scores.

[1] For discussion of a statistical analysis of pre- and post-test scores in two or more groups, see Huck and McLean (1975).

Table 2
Descriptive Statistics of the Pre- and Post-test Scores

		Pre-test		Post-test	
	n	*M*(*SD*)	95% CIs	*M*(*SD*)	95% CIs
Baseline	17	21.88(2.23)	[20.73, 23.03]	21.71(3.35)	[19.98, 23.43]
Embodied	21	20.71(4.19)	[18.81, 22.62]	23.29(4.15)	[21.40, 25.17]
Non-embodied	21	19.67(4.60)	[17.57, 21.76]	22.10(4.40)	[20.09, 24.10]

Note. CIs = confidence intervals.

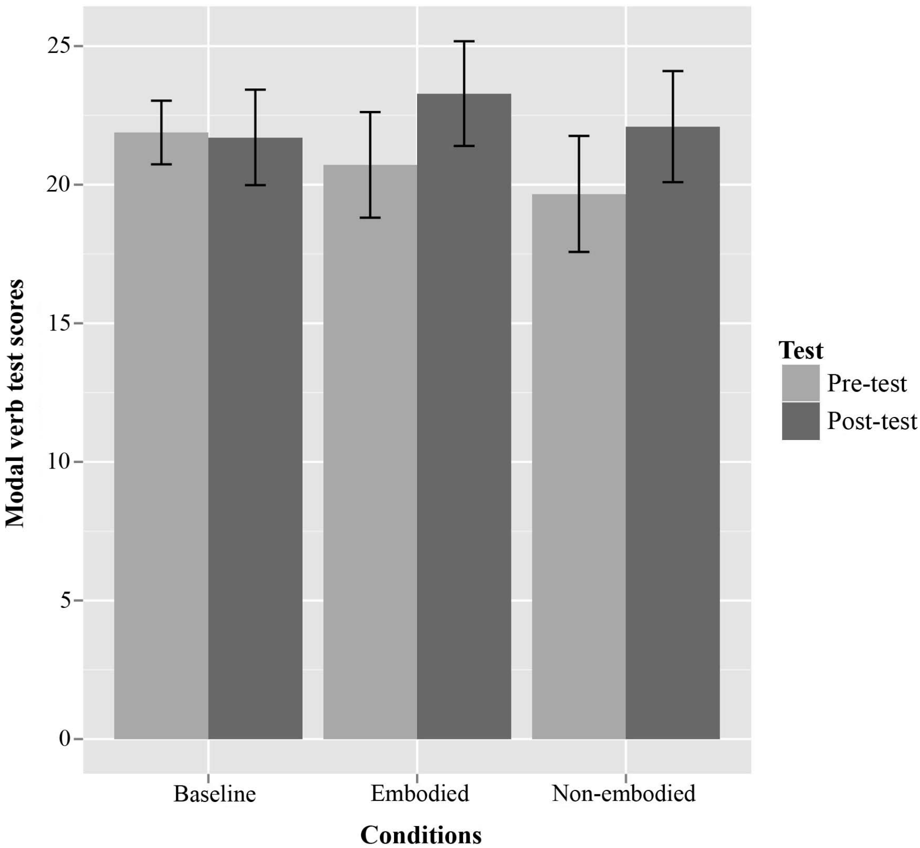

Figure 4. Changes from Pre- to Post-test Scores. Error bar represents 95% CIs.

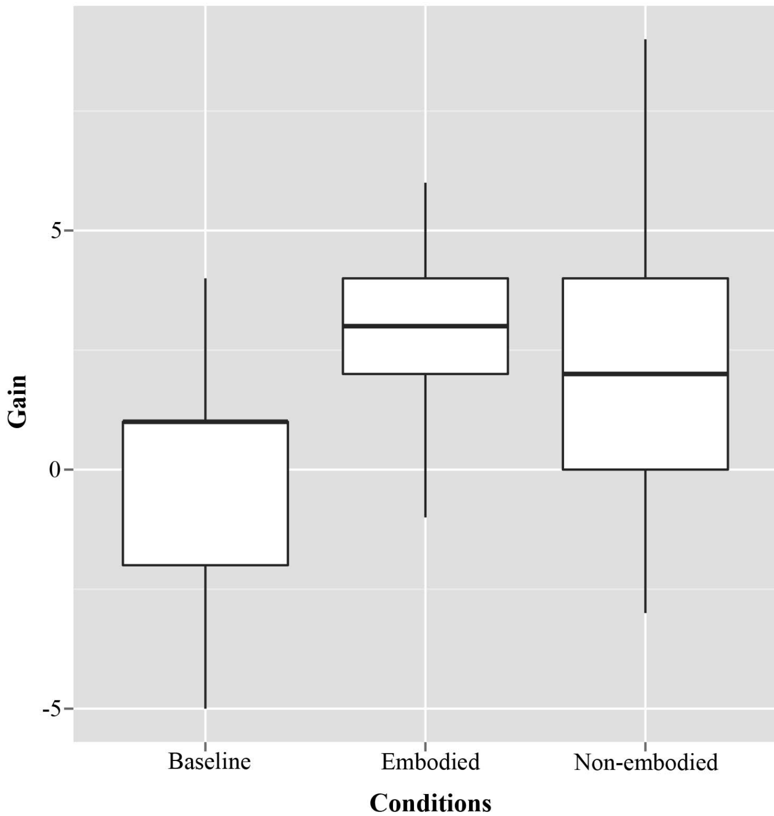

Figure 5. Distribution of Participants' Gain Scores. Mean gain score and standard deviation for each group are as follows: Baseline = -0.18(2.53); Embodied = 2.57(1.81); and Non-embodied = 2.43(3.40).

4. Discussion

To recap, participants in the embodied and non-embodied (i.e., speech act) conditions improved on their post-test scores after a brief exposure to the modal verb training. However, participants in both groups did not differ significantly from each other. That said, the results stand in contrast with those of previous studies (Tyler et al., 2010; see also Tyler, 2008) which demonstrated a slight, yet significant advantage of cognitive linguistic descriptions of English modals over speech-act, functional explanations. Also, of particular importance here is that the participants exposed to speech-act explanations improved on their test scores, whereas those in the similar grouping in Tyler et al. (2010) did not. As for the present study, when care was taken to control for any confounding factors, embodied learning did not yield statistically better results on the test scores. The non-significant results merit some discussion. Firstly, by trying to instantiate the two different conceptual aspects of English modals, the force dynamics game had to simplify a number of complex elements underlying the semantics of root and epistemic readings. Most notably, the game represented the epistemic reading with a magnifying glass. While this made the epistemic scenes compatible with those of root meaning, the presentation might have rendered the meaning less clear and—as one anonymous reviewer noted—less complete. In addition, recall that there were fewer numbers of epistemic prompts in the force dynamics game but an equal number of questions between root and epistemic meanings in the tests. This discrepancy might have inevitably affected participants' test scores.[2] Secondly, whereas the

[2] One anonymous reviewer noted that phrasal cues in the test questions (e.g., "absolutely" and "if we'd like") might have primed the participants to choose one answer over another. However, this did not seem to be the case. Participants' response to these questions was varied. For example, some participants answered *should* despite the word "absolutely" in the prompt.

learning phase in Tyler et al. (2010) spanned a few days, it was only an hour or so in this study. Participants may have needed more time to integrate force dynamics into their conceptual frame of modal verbs. Providing more time for the participants to conceptualize modal verbs through the lens of force dynamics might have allowed them to outperform the other group.

Despite showing the same modest gains in test scores as their counterparts, participants in the embodied condition had an arguably more challenging job because they engaged in the novel way of learning modal verbs. On the other hand, participants in the non-embodied group were exposed to the materials slightly similar to the ones they had learned in their English class. This novel way of learning embodied English modals might have confused participants or even worse had a negative effect on their test scores. Nonetheless, this was not the case; participants did still improve.

We can now interpret the previous studies in light of the current work. The gains in the cognitive linguistic group over the speech act group in Tyler et al. (2010) dissipated when confounding factors were tightly controlled. Therefore, it seems that such gains might have been due to a confluence of explicit teaching, immediate feedback, or even repeated exposure to the materials.

This does not mean that embodied learning plays an insignificant role in L2 learning. In fact, quite the opposite can be argued. Embodied learning can offer an elegant, yet intuitively simple way for L2 users to grasp complex constructions such as English modals as well as subtle, yet difficult grammatical items such as prepositions (MacWhinney, Presson & Heilman, 2010; Onnis et al., 2010; Tyler & Evans, 2003). Embodied learning activities such as the force dynamics game in the present study may allow L2 users to strengthen form-meaning pairings of English modals, utilizing the embodied experiences each modal verb entails. In addition, it can afford L2 users optimal opportunities to study modal verbs and eschew a list of explanations and functions learners have to memorize. An effective teaching intervention can utilize embodied learning activities with an aim to help L2 users understand the semantics of English modals before moving on, through communicative practice that is often found in speech-act exercises, to real-world tasks (e.g., legal writing) that require modal verbs for task completion (Abbuhl, 2005; Tyler, 2008; see also Tyler, 2012).

Future studies are needed to demonstrate the efficacy of embodied L2 learning of English modals across various groups of participants and the impact of such learning on (near-)native-like ability to use modal verbs in a wide range of contexts (see, e.g., Langacker, 2008). Future studies would also benefit from focusing solely on root meaning, which has a stronger connection to the physical world (Sweetser, 1990; Talmy, 1988) than the epistemics, and once L2 users have demonstrated their ability to use the modals productively, research can then target the epistemic meaning. This design may allow research to inform teaching as to how and when the two readings should be taught.

The present study was conducted with participants who had quite extensive experience in studying English. That said, they must have already encountered English modals in their English class and knew certain things about this construction. This background knowledge might have mediated the results obtained in this study. Ostensibly, randomizing participants to different groups might have reduced the effects of background knowledge; however, it did not eliminate the background knowledge *per se*. Future research could benefit from testing embodied learning in beginner L2 users and employ a series of training sessions, instead of just one, with increasing difficulty in terms of sentence constructions and scenarios. However, testing beginner L2 users means, in most foreign language teaching contexts, finding participants of a younger age. Materials may then have to be adapted and tailored to suit a certain age group while still maintaining a rigorous experimental control. With many more studies, a clearer picture of how embodiment plays a role in modal verb learning may emerge, and the efficacy of such learning can be evaluated with greater confidence.

A few important questions vis-à-vis embodied learning of modal verbs that have eluded us and that future research should begin to answer are (1) how modal verbs are embodied and to what extent, and (2) how the mapping between force dynamics and modal verbs occurs. While the bulk of research has demonstrated that space as a concrete experience structures an abstract concept of time (see, e.g., Boroditsky, 2011 for a review), no empirical data is available to show the mapping of the concepts of force and gravity onto such abstract linguistic concepts as modal verbs. Basic research testing the psychological reality of such mapping can inform applied research as well as offer insights for L2 learning and teaching.

Appendix: Sample of sentence prompts

MODAL VERBS			
Must	**Will**	**May**	**Should**
You ***must*** meet my friend.	You ***will*** meet my friend.	You ***may*** meet my friend.	You ***should*** meet my friend.
You ***must*** finish the report today.	You ***will*** finish the report today.	You ***may*** finish the report today.	You ***should*** finish the report today.
You ***must*** eat this food.	You ***will*** eat this food.	You ***may*** eat this food.	You ***should*** eat this food.
You ***must*** buy a newspaper.	You ***will*** buy a newspaper.	You ***may*** buy a newspaper.	You ***should*** buy a newspaper.
You ***must*** watch this film.	You ***will*** watch this film.	You ***may*** watch this film.	You ***should*** watch this film.
You ***must*** write a book now.	You ***will*** write a book now.	You ***may*** write a book now.	You ***should*** write a book now.
You ***must*** use your money.	You ***will*** use your money.	You ***may*** use your money.	You ***should*** use your money.
You ***must*** study English.	You ***will*** study English.	You ***may*** study English.	You ***should*** study English.
You ***must*** drive a car.	You ***will*** drive a car.	You ***may*** drive a car.	You ***should*** drive a car.
You ***must*** call the hotel.	You ***will*** call the hotel.	You ***may*** call the hotel.	You ***should*** call the hotel.

References

Abbuhl, Rebekha (2005). *The effect of feedback and instruction on writing quality: Legal writing and advanced L2 learners* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3175845)

Adam, Hajo, & Galinsky, Adam (2012). Enclothed cognition. *Journal of Experimental Social Psychology*, *48*, 918-925.

Bachman, Lyle (1985). Performance on cloze tests with fixed-ratio and rational deletions. *TESOL Quarterly*, *19*(3), 535-556.

Barsalou, Lawrence (1999). Perceptual symbol systems. *Behavioral and Brain Sciences*, *22*, 577-660.

Barsalou, Lawrence (2008). Grounded cognition. *Annual Review of Psychology*, *59*, 617-645.

Barsalou, Lawrence (2009). Simulation, situated conceptualization, and prediction. *Philosophical Transactions of the Royal Society, Biological Sciences*, *364*, 1281-1289.

Boers, Frank, & Lindstromberg, Seth (Eds.). (2008). *Cognitive linguistic approaches to teaching vocabulary and phraseology*. Berlin: Mouton de Gruyter.

Boroditsky, Lera (2011). How languages construct time. In Stanislas Dehaene & Elizabeth Brannon (Eds.), *Space, time, and number in the brain: Searching for the foundations of mathematical thought* (pp. 333-341). London: Elsevier.

Casasanto, Daniel, & Chrysikou, Evangelia (2011). When left is "right": Motor fluency shapes abstract concepts. *Psychological Science*, *22*, 419-422.

Celce-Murcia, Marianne, & Larsen-Freeman, Diane (1999). *The grammar book: An ESL/EFL teachers' course* (2nd ed.). Boston, MA: Heinle & Heinle.

Chen, Mark, & Bargh, John (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin*, *23*, 215-224.

Croft, William, & Cruse, Alan D. (2004). *Cognitive linguistics*. Cambridge: Cambridge University Press.

Ellis, Nick C. (2008). Usage-based and form-focused language acquisition: The associative learning of constructions, learned attention, and the limited L2 endstate. In Peter Robinson & Nick C. Ellis (Eds.), *Handbook of cognitive linguistics and second language acquisition* (pp. 372-405). New York, NY: Routledge.

Gibbs, Raymond (2005). *Embodiment and cognitive science*. New York, NY: Cambridge University Press.

Huck, Schuyler, & McLean, Robert (1975). Using a repeated measures ANOVA to analyze the data from a pretest-posttest design: A potentially confusing task. *Psychological Bulletin*, *82*, 511-518.

Iacoboni, Marco (2009). Imitation, empathy, and mirror neurons. *Annual Review of Psychology*, *60*, 653-670.

Iacoboni, Marco, Molnar-Szakacs, Istvan, Gallese, Vittorio, Buccino, Giovanni, Mazziotta, John, & Rizzolatti, Giacomo (2005). Grasping the intentions of others with one's own mirror neuron system. *PLoS Biology*, *3*(3), e79. doi:10.1371/journal.pbio.0030079

Jostmann, Nils, Lakens, Daniël, & Schubert, Thomas (2009). Weight as an embodiment of importance. *Psychological Science*, *20*, 1169-1174.

Lakoff, George, & Johnson, Mark (1980). *Metaphors we live by*. Chicago, IL: The University of Chicago Press.

Lakoff, George, & Johnson, Mark (1999). *Philosophy in the flesh: The embodied mind and its challenge to Western thought*. New York, NY: Basic Books.

Langacker, Ronald (2008). Cognitive grammar as a basis for language instruction. In Peter Robinson & Nick C. Ellis (Eds.), *Handbook of cognitive linguistics and second language acquisition* (pp. 66-88). New York, NY: Routledge.

MacWhinney, Brian (1999). The emergence of language from embodiment. In Brian MacWhinney (Ed.), *The emergence of language* (pp. 213-256). Mahwah, NJ: Lawrence Erlbaum.

MacWhinney, Brian (2008). How mental models encode embodied linguistic perspectives. In Roberta Klatzky, Brian MacWhinney, & Marlene Behrmann (Eds.), *Embodiment, ego-space, and action* (pp. 365-405). Mahwah, NJ: Lawrence Erlbaum.

MacWhinney, Brian, Presson, Nora, & Heilman, Michael (2010, October). *Embodied spatial language in L2 acquisition*. Paper presented at the Second Language Research Forum, Maryland, MD.

Marian, Viorica, Blumenfeld, Henrike, & Kaushanskaya, Margarita (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research*, *50*, 1-28.

Neisser, Ulric (1967). *Cognitive psychology*. New York, NY: Prentice Hall.

Onnis, Luca, Jackson, Daniel, & Spivey, Michael (2010). Perceptual simulations of temporal uses of *In* and *On* in first and second language processing. *Proceedings of the 32nd Annual Meeting of Cognitive Science Society* (pp. 889-894). Austin, TX: Cognitive Science Society.

Radden, Gunter, & Dirven, Rene (2007). *Cognitive English grammar*. Amsterdam: John Benjamins.

Robbins, Philip, & Aydede, Murat (2009). A short primer on situated cognition. In Philip Robbins & Murat Aydede (Eds.) *The Cambridge handbook of situated cognition* (pp. 3-10). New York, NY: Cambridge University Press.

Smith, Linda, & Gasser, Michael (2005). The development of embodied cognition: Six lessons from babies. *Artificial Life*, *11*, 13-29.

Spivey, Michael (2007). *The continuity of mind*. New York, NY: Oxford University Press.

Spivey, Michael, & Geng, Joy (2001). Oculomotor mechanisms activated by imagery and memory: Eye movements to absent objects. *Psychological Research*, *65*, 235-241.

Stanfield, Robert, & Zwaan, Rolf (2001). The effect of implied orientation derived from verbal context on picture recognition. *Psychological Science*, *12*(2), 153-156.

Sweetser, Eve (1990). *From etymology to pragmatics: Metaphorical and cultural aspects of semantic structure*. Cambridge: Cambridge University Press.

Talmy, Leonard (1988). Force dynamics in language and cognition. *Cognitive Science*, *12*, 49-100.

Talmy, Leonard (2000). *Toward a cognitive semantics* (Vol. 1). Cambridge, MA: MIT Press.

Taylor, Lawrence, & Zwaan, Rolf (2009). Action in cognition: The case of language. *Language and Cognition*, *1*, 45-58.

Tyler, Andrea (2008). Cognitive linguistics and second language instruction. In Peter Robinson & Nick C. Ellis (Eds.), *Handbook of cognitive linguistics and second language acquisition* (pp. 456-488). New York, NY: Routledge.

Tyler, Andrea (2012). *Cognitive linguistics and second language learning: Theoretical basics and experimental evidence*. New York, NY: Routledge.

Tyler, Andrea, & Evans, Vyvyan (2003). *The semantics of English prepositions: Spatial scenes, embodied meaning and cognition*. Cambridge: Cambridge University Press.

Tyler, Andrea, Mueller, Charles, & Ho, Vu (2010). Applying cognitive linguistics to instructed L2 learning: The English modals. *AILA Review*, *23*, 30-49. doi:10.1075/aila.23.03tyl

West, Michael (1953). *A general service list of English words*. London: Longman.

Wilson, Margaret (2002). Six views of embodied cognition. *Psychonomic Bulletin & Review*, *9*(4), 625-636.

Zwaan, Rolf, & Madden, Carol (2005). Embodied sentence comprehension. In Diane Pecher & Rolf Zwaan (Eds.), *Grounding cognition: The role of perception and action in memory, language and thinking* (pp. 224-245). New York, NY: Cambridge University Press.

Selected Proceedings of the 2012 Second Language Research Forum: Building Bridges between Disciplines

edited by
Ryan T. Miller, Katherine I. Martin, Chelsea M. Eddington, Ashlie Henery, Nausica Marcos Miguel, Alison M. Tseng, Alba Tuninetti, and Daniel Walter

Cascadilla Proceedings Project **Somerville, MA** **2014**

Copyright information

ISBN 978-1-57473-464-5 library binding

Ordering information

Orders for the library binding edition are handled by Cascadilla Press.
To place an order, go to www.lingref.com or contact:

Cascadilla Press, P.O. Box 440355, Somerville, MA 02144, USA
phone: 1-617-776-2370, fax: 1-617-776-2271, sales@cascadilla.com

Web access and citation information

This entire proceedings can also be viewed on the web at www.lingref.com. Each paper has a unique document # which can be added to citations to facilitate access. The document # should not replace the full citation.

This paper can be cited as:

Suethanapornkul, Sakol. 2014. Embodied Experiences in Second Language Learning of English Modal Verbs. In *Selected Proceedings of the 2012 Second Language Research Forum*, ed. Ryan T. Miller et al., 181-192. Somerville, MA: Cascadilla Proceedings Project. www.lingref.com, document #3096.