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Effectiveness of force dynamic explanations of English causative verbs and the role of imagery

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Abstract: The current study examines the effectiveness of a CL-based force dynamic (FD) lesson relative to a more conventional approach that seeks to convey the target semantics through corresponding L1 forms. Exp. 1 ($N = 67$) examined Japanese EFL students' acquisition of the English verbs *force, get, have, help, let, make*, and *prevent*, comparing the effectiveness of force dynamic explanations with dynamic diagrams and a translation-based approach. Both groups showed significant learning on both the posttest and delayed posttest, but the FD group's greater gains over the conventional instruction on both the posttest and delayed posttest did not reach significance. Exp. 2 ($N = 97$) replicated most of the Exp. 1 conditions but with a slightly altered instructional format to ensure participant's focus on force dynamic relationships. The FD group's greater gains on a posttest given three weeks following instruction fell short of statistical significance. Exp. 3 ($N = 54$) compared the effectiveness of a FD lesson using dynamic images with a lesson without such images and found no significant differences between the groups. The three experiments demonstrate that CL-based instruction on force dynamics provides a viable alternative to conventional instruction in which target semantics are conveyed through translation.

Keywords: force dynamics, schema-based instruction, causative, imagery, explicit instruction

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1 Introduction

1.1 Overview

In the field of second language acquisition (SLA), there is a long tradition of conveying the meaning of words and grammatical patterns by means of L1 translation equivalents. A possible drawback to this approach is that semantic patterning and the construal of situations often differ dramatically between the L1 and target language. There has, therefore, been interest in pedagogical approaches that highlight L2 semantics directly without reliance on translation. The experiments in this paper examine the effectiveness of one such approach. Specifically, Exp. 1 and Exp. 2 compare the effectiveness of lessons based on the explanations of force dynamic (FD) explanations put forth in Cognitive Linguistics (CL) with a more conventional approach that relies on translation to convey the semantics of L2 forms. The FD instructions in the first two experiments both rely on animated images to convey the target semantics of English verbs such as *make* and *let*. To determine whether this imagery is a crucial element of the CL instruction, Exp. 3 compares the effectiveness of force dynamics instruction employing animated imagery with instruction without such imagery.

1.2 Literature review

In SLA, a general consensus has emerged that learning is greatly facilitated by explicit instruction, that is, instruction which involves "rule explanation" or encourages learners to "directly attend to forms" so as to "arrive at metalinguistic generalizations on their own" (Norris and Ortega 2000: 437). Goo et al. (2015) for example, in their meta-analysis of recent studies comparing implicit and explicit instruction, report large average effect sizes for explicit interventions on immediate posttests ($g = 1.36$) and short-delayed posttests ($g = 1.02$), and medium to large effects ($g = 0.75$) for long-delayed (30 days or more) posttests. Research has also shown larger effect sizes for explicit instruction relative to implicit instruction (Goo et al. 2015; Norris and Ortega 2000; Spada and Tomita 2010).

In SLA, there is also a fairly broad agreement that explicit learning via explicit instruction is a necessary steppingstone for most adult learners aiming at high levels of L2 proficiency (Leaver and Atwell 2002; Leow 2015). Moreover, explicit learning and the resulting explicit knowledge appears to play a critical role in the formation of *implicit* knowledge in adult L2A (DeKeyser 2015; N. C. Ellis 2015). As a result, researchers, L2 instructors, and SLA materials developers

have worked to create pedagogical materials that effectively draw learners' attention to L2 form-meaning associations so as to promote learners' noticing, and in many cases, metalinguistic awareness, of form-meaning links (for a discussion of the role of attention in SLA, see Leow 2015; Schmidt 2001).

While much of the research on explicit instruction has focused on grammar, studies have examined lexical acquisition as well. According to Jiang (2000), the initial stages of word learning involve establishment of a lexical entry with formal specifications, which allows for the copying of information from the L1 counterpart to the L2 lexical entry. A final stage of acquisition, which learners sometimes fail to reach, involves integrating into the entry the precise L2 semantic, syntactic, and morphological specifications. Learners' acquisition of the precise semantic scope of target words may, in many cases, develop over time through implicit learning as the learner gradually forms precise semantic categories as a result of multiple encounters with the word in different contexts. Yet learners at even advanced levels of proficiency often fail to acquire the semantics of some very common words in spite of these words' frequent occurrence in the input (Ijaz 1986; Mueller 2011). This has led to an interest in pedagogical interventions that facilitate the acquisition of words with complex semantics, particularly function words and words that fill key slots in multiword constructions.

Renewed impetus for this endeavor has come from researchers in the area of cognitive linguistics (CL). This theoretical approach has revealed systematicity in areas of language that have been traditional regarded as arbitrary and full of exceptions, and has thus raised the possibility that many opaque and seemingly intractable areas of language are potentially amenable to instruction (Tyler 2012, Tyler 2017). In L2 pedagogy, recently developed CL approaches attempt to foster learner awareness of experience-based structures, called image schemas, that underlie the semantics of target L2 forms (for relevant theoretical discussions, see Johnson 1987; Lakoff 1987; Langacker 1987). The effectiveness of such approaches has been explored for a wide range of linguistic targets to include English modals (Tyler et al. 2010), prepositions and spatial particles (Cho 2010; Englund 2015; Lam 2009; Masuda and Labarca 2015; Tyler et al. 2011), phrasal verbs (Yasuda 2010), and metaphorical word use (Boers 2000; Csábi 2004). Boers (2013), in his overview of CL-based research that has specifically focused on vocabulary acquisition, lists 19 studies that have compared CL-based approaches with alternatives. Nearly all of these studies show an advantage for the CL instruction. However, Boers points to a number of shortcomings with this research, such as instances in which the instruction given to the CL and comparison groups is different in ways unrelated to the independent variable (i.e. the type of instructional approach).

CL approaches have focused on image schemas, yet it should be noted that the term *image schema* is unfortunate since the thus-designated cognitive structures (e.g. Containment or Straightness) are not directly related to imagery. Even so, a number of researchers have, for sound reasons, employed pictorial representations in order to convey the targeted image schema when conducting experimental interventions. The rationale for using abstract imagery in L2 instruction goes beyond CL theoretical assumptions. Pedagogical use of imagery can, in fact, be justified in light of general encoding and retrieval processes in memory. The Dual Coding Hypothesis, for example, maintains that verbal and nonverbal codes are functionally independent in working memory and as a result, information that is encoded in terms of both words and images is more easily recalled (Paivio 2007, Paivio 2010). Mayer (2011) has systematically applied these ideas broadly to pedagogical interventions involving multimedia. He argues that coherent presentations in which onscreen visualizations are combined with verbal explanations (often to provide redundant information) are highly effective for a wide range of purposes, to include vocabulary instruction.

To determine whether CL-based instruction, and more specifically, instruction using force dynamics leads to both immediate and more long-term gains in learning and whether it facilitates acquisition more effectively than a conventional approach, this paper reports the results of three experiments that target English verbs that express force dynamic relationships. In the Cognitive Linguistics tradition, force dynamics break down the notion of causatives into more fine-grained distinctions. In Talmy's (1988) seminal work, for example, force dynamic patterns are depicted in terms of an *agonist* (the focal force) and an *antagonist* (the element opposing the focal force). These two forces are viewed as having opposing tendencies: if the agonist has a tendency towards motion, the antagonist has an inherent tendency towards rest, and vice versa. The outcome of the struggle between these opposing forces is determined by their relative strength. A further factor involves the shift in force dynamic forces. The situation expressed by English *let*, for example, involves a weaker agonist with a tendency toward movement and a stronger antagonist with potential to block the movement. The latter removes the blocking force, allowing the inherent tendency of the agonist to be realized.

There are many common force dynamic verbs in English (e.g. *get, have, help, let*, and *make*) and some of these verbs (especially *have* and *get*) occur in a wide range of patterns. In the current experiments, both the experimental interventions and measures targeted only the verbs' most prototypical force dynamic senses.

The analysis of the target verbs used in the study was largely based on previous research and took into account the following points. Regarding *make*, the force dynamic sense appears syntactically in both adjective structures (e.g. *make*

something possible) and verb structures (*make him realize*). With the bare infinitive construction, it often depicts direct control causation (Givón 1980), in which case the agonist is generally assumed to resist the outside force. However, it has an additional sense when used with verbs of emotion (e.g. *made him feel happy*) and verbs of psycho-physiological reaction (e.g. *made her cry*). In our analysis, this is based on a folk-theory that views human emotions as involving a force dynamic configuration in which the self (as the agonist) has an inherent tendency to resist the emotion (viewed as a powerful external force). This folk theory is evident in metaphorical expressions such as *She was overcome by joy* and *She struggled with doubts* (cf. the discussion of the folk theory of emotion in Kövecses 2010: 110). With *make*, the most frequent combination of variables is said to be that of an inanimate antagonist, an animate agonist, and a non-volitional effect (Gilquin and Lecoutre 2004). It has been noted that *make* can be used for events that are brought about accidentally, as in *Oops! I made you miss your bus* (Kudrnáčová 2014).

Force implies that the agonist has no choice or options; hence, the resulting action is absolutely coerced. In many situations, *force* is used to show physical coercion (since the agonist cannot avoid the action) or the coercive force of strong societal norms. In contrast with *make*, the agonist is typically viewed as putting forth strong resistance.

Get is described by Talmy as a force dynamic verb associated with "socio-psychological" domains (Talmy 2000: 412). It is similar to *make*; however, *get* generally implies difficulty and the need for sustained force by the antagonist to overcome the inertia of the agonist. For this reason, it is often preceded by *finally* (e.g. *He finally got her to leave*.) It is frequently associated with persuasion and is often preceded by *try, manage, succeed*, and *attempt* (Gilquin 2003). In most cases, both the antagonist and agonist are animate. As a causative, it is more common than *have*, but the frequencies are similar (Gilquin 2003).

Have is similar to *make* and *get*; however, it tends to be preferred when the predilections of the agonist are of no interest within the discourse context. This may explain why it often appears in past-participle constructions in which the agonist is not explicitly mentioned (e.g. *She had the work done*). The ability or authority of the antagonist is often assumed (e.g. *The teacher had the students close their books*). As Gilquin (2003) points out, it occurs frequently in situations involving service interactions (e.g. *I had my car repaired*). The antagonist tends to be animate and difficulty is not implied (Gilquin 2003). Although it appears in many non-causative constructions (which are not targeted in the present study), the force dynamic interpretation is dominant in both British and American English (Martinková 2014).

Help typically occurs with the bare infinitive. It depicts a force dynamic situation in which the agonist's inaction, rather than being due to intentional

resistance, is due to a lack of ability or power. The collocating verbs often involve directed action toward a particular task (e.g. *helped her find*, *helped her make*). Like *make, help* often collocates with psycho-physiological states and reactions (e.g. *relax, understand, forget, sleep*, and *cope*)

Let, unlike the verbs discussed thus far, depicts a more complex situation in which an antagonist that has the ability to block the agonist's action, removes the potentially blocking force, thus allowing the action. It tends to occur with many high-frequency verbs (e.g. *go, do, have, take*, etc.) *Prevent* is similar, but it depicts a situation in which the antagonist stops the action of the agonist. The blocking is conceived of as occurring prior to the agonist's commencement of action, hence *prevent*, in this respect, contrasts with *stop*.

The targeted verbs were selected as research suggests that causative constructions are especially difficult for nonnative speakers (NNSs). For example, both Wong (1983) and Liu and Shaw (2001) have found that Chinese learners experience difficulty in acquiring the semantics of English *make*. Similar results have been reported for other L1 populations (Altenberg and Granger 2001; Helms-Park 2001). Difficulties are also likely to occur for Japanese EFL learners (the focus of the current study) due to the imprecise overlap between the linguistic forms expressing force dynamics in English and Japanese. While a detailed comparison is beyond the scope of this paper, a few examples may be instructive.

Japanese uses the causative construction *–(s)ase* to express the meanings often expressed by English *make, let, have*, and so on. This construction does not specify the natural tendency of the agonist, which must often be inferred based on extra-linguistic information or encyclopedic knowledge. Consider the following example taken from a comprehensive Japanese grammar (Kaiser et al. 2013: 391).

(1) *Oya-ga* *kodomo-wo* *gakkoo-ni* *ik-ase-ru*
Parents-nominative child-object school-dative go-causative verbal suffix
'The parents make/let the child go to school.'

In other examples of the *–(s)ase* construction from the same grammar book, both *make* and *let* are often given as alternative translations of *–(s)ase* in the Japanese sentences.

Another frequently encountered construction in Japanese is V- *te morau*/*itadaku* pattern. Sentences using the *–te morau/itadaku* pattern are often rendered using force dynamic verbs such as *have, let*, and *allow* when translated into English. *Morau* and *itadaku*, when occurring as independent lexical items, mean "to receive" (*itadaku* is the humble form). The pattern occurs in the following sentence (Kaiser et al. 2013: 395):

(2) *Jiko shookai* *sase-te* *itadaki-masu*
Self introduction do-causative verbal suffix receive-verbal suffix
'Please allow me to introduce myself.'

The above examples provide only a few examples of force dynamics in Japanese, but even so, several clear differences are apparent. First, English force dynamics tend to be expressed through lexical items (e.g. the meanings associated with verbs such as *make, let, have, get*, etc.), whereas Japanese exhibits a tendency to express these meanings through post-verbal morphology. Second, the Japanese causative constructions employed to express force dynamics typically do not clearly express the predilections of the agonist. This may reflect general typological differences between Japanese and English. Japanese has been described as a "process-oriented" language which contrasts with languages such as English, in which "action schema with its focus on the goal is dominant" (Ikegami 2000: 194). Third, Japanese, as an agglutinative language, has a rich repertoire of combined constructions. As seen above, the *-(s)ase-* causative construction can be combined with the *-te morau/itadaku* construction, which in turn can be realized as a regular (*morau*) or humble form (*itadaku*). To cite another example, the *–(s)ase-* causative construction can combine with suffixed passive morphology to create a causative-passive construction that means "to be made to do something" or "to be given the opportunity to feel/discover something" (Kaiser et al. 2013: 397). In many cases in Japanese sentences, the inherent tendency of the agonist becomes apparent due to the combined force of the morphology that makes up the larger construction.

These differences between Japanese and English are likely to hamstring learners' initial attempts to find straightforward L2-L1 correspondences (i.e. translations) that can reliably aid in learning English force dynamic verbs. The following three experiments thus examine the effectiveness of instruction that attempts to bypass the L1 and convey the meanings of the L2 forms more directly through abstract imagery based on force dynamic analyses of target verb semantics.

2 Experiment 1

2.1 Method

A number of studies have shown that at least in the initial stages, studying words through L1 translations can be highly effective (Laufer and Shmueli 1997; Lotto and De Groot 1998; Ramachandran and Rahim 2004). Moreover, a number

of theoretical models suggest that initial learning via L1 translation equivalents is a natural and perhaps inevitable phase in adults' initial L2 lexical acquisition (Jiang 2000, Jiang 2004; Kroll and Stewart 1994). However, L1 translation may not be adequate as learners work to acquire the precise semantics of words lacking close L1 equivalents. When acquiring these forms, L2 learners, after an initial phase in which the "L2 is parasitic on [the] L1" must "reduce this parasitism by building up L2 representations as a separate system" (MacWhinney 2008: 348). In developing refined representations, previous research such as that reviewed in the introduction suggests that learners may benefit from CL-based explanations that highlight the target word's abstract meaning. Exp. 1 thus tested whether using a force dynamic approach is more effective than a translation-based approach for the teaching force dynamic verbs.

2.1.1 Participants

The participants ($N = 67$) were first-year Japanese-L1 female EFL learners at a private women's university in Japan who were in a department focusing on linguistics and literature. Although the participants' program of study included multiple courses introducing CL theory, none of these classes were open to first-year students; hence the CL instruction provided as one of the treatments in Exp. 1 would have been, in all likelihood, the participants' first exposure to systematic CL-based explanations of a linguistic structure. All but four of the participants had taken the paper-based TOEFL a couple months prior to the experiment. Their scores are shown in Table 1. In terms of the Common European Framework of Reference (CEFR), they could be described as being roughly at the low B1 level. They were motivated learners, many of whom aspire to enter career fields requiring English.

Table 1: Exp. 1 participants' English proficiency as assessed by the TOEFL PBT.

TOEFL PBT Test Section	*M* (*SD*)	Range
Listening Comprehension	44.2 (2.7)	35–49
Structure/Written Expression	40.0 (4.8)	31–48
Reading Comprehension	40.8 (5.1)	31–50
TOTAL SCORE	416.5 (28.6)	350–470

The participants came from four intact first-year required English reading classes. Two of the classes were randomly assigned to the Force Dynamics

(FD) condition ($n = 29$) and two were assigned to the Translation condition ($n = 38$). The inclusion of a translation-based instruction condition in Exp. 1 and Exp. 2 reflects the fact that translation is frequently employed in instruction at all levels in Japan, with some teachers (e.g. Izumi 1995) arguing for its superiority over instructional approaches requiring learners to induce meaning of target forms based on context.

The participants in both groups were taught seven English verbs (*force*, *get*, *have*, *help*, *let*, *make*, and *prevent*), which are used to express force dynamic relationships. These verbs were chosen as they are, for the most part, high-frequency force dynamic verbs that tend to be problematic for L2 learners. The decision to focus on this particular number of verbs reflects time constraints: piloting of the materials suggested that this number of target items could be covered within a single 90-minute class period. Those in the FD condition received instruction based on a CL analysis of force dynamics. Those in the Translation condition received conventional instruction that taught the meaning of the target verbs via L1 (i.e. Japanese) translation equivalents.

2.1.2 Materials

All participants in Exp. 1 were taught by the second author, a NS of Japanese. He was not the participants' regular class instructor. For the FD instruction, a slide presentation was created using the Apple Keynote program. The beginning of the presentation introduced basic elements of force dynamic relationships through the depiction of a stick figure in a box (representing the agonist) and an external figure on the left who exerts an effect (representing the antagonist). An arrow was shown stretching from the antagonist toward the agonist (showing an effect) and another arrow was drawn to the right of the agonist (depicting the resulting action). These four aspects of the force dynamic situation (i.e. the tendency of the antagonist, the strength of the exerted force, the tendency of the agonist, and the outcome) were thus shown using animated figures for all target verbs.

After this introduction, a CL-based explanation of each force dynamic verb was provided based on modifications of the original picture. For example, the slide for *make* (see Figure 1) showed an antagonist pushing an agonist who was leaning back (i.e. resisting this force). The figure for the agonist initially jiggled (a depiction of resistance), but then moved forward (a depiction of the outcome of the force dynamic interaction).

This slide was followed by three examples in which the sentence components were mapped onto the force dynamic figure, as shown in Figure 2.

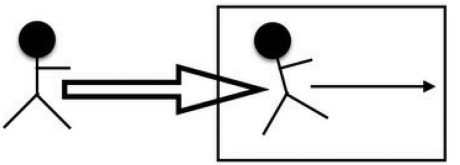

Figure 1: Slide from the FD intervention, showing the force dynamics of the verb *make*. In the actual slide, both arrows and the figure on the right are animated.

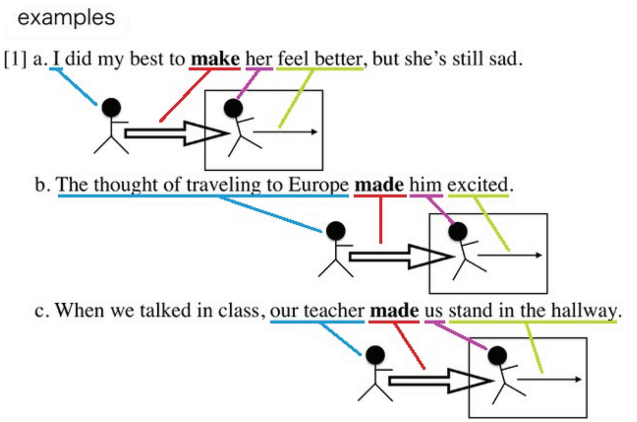

Figure 2: A slide from the FD group's instruction, mapping the force dynamic elements from the pictorial elements to the corresponding elements in three example sentences.

The changes in force dynamics were depicted through systematic changes in the images. For example, the slide for *force* (see Figure 3) was virtually the same as that of *make*; however, the antagonist's force was depicted as stronger through the use of thick lines for the first arrow and the agonist was shown leaning back at a sharper angle while jiggling longer before assuming a forward trajectory.

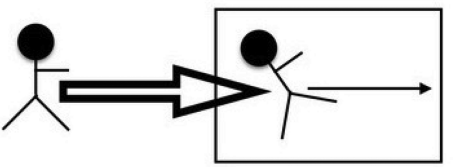

Figure 3: A slide showing the force dynamics of the verb *force*. Notice that the arrow on the left has heavier bolding and the agonist is leaning back more, showing greater resistance.

Fading was used to depict the disappearance of an external force, as when the antagonist ceases to prevent an agonist's action (the situation described by *let*). Fading was also used as in Figure 4 to show that the verb *have* tends to highlight the antagonist while de-emphasizing the predilections of the agonist.

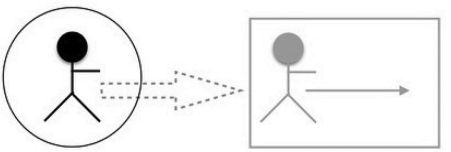

Figure 4: A slide showing the force dynamics of the verb *have*. Fading of the agonist shows that the agonist's inherent tendency is of little importance within the discourse context.

The initial part of the slide presentation thus went through seven force dynamic situations (all depicted by animated stick-figure images) followed by three example sentences in which the components were systematically mapped onto (1) the antagonist, (2) the strength and type of force, (3) the agonist, and (4) the outcome.

At the end of the slide presentation, a slide showed depictions of the seven relationships without the verbs. (The verbs were to be supplied by participants). Participants were then shown a slide with a sentence missing a force dynamic verb. The sentence was accompanied by a picture (depicting the situation) along with the abstract image of the force dynamic relationship. An example is shown in Figure 5. Participants were asked to fill in the sentence. The picture on the lower left of the slide served to help the participants readily identify the sentence's intended meaning. An abstract depiction of the force dynamics is provided below the sentence, focusing the participants' attention on the fact that the desires of the agonist ("me" in the sentence) are de-emphasized and therefore *have* (in this case, past tense *had*) is the intended verb.

After participants did the first fill-in-the-blank exercise as a class, reviewing answers after each question, they got into pairs and worked with their partner on another seven fill-in-the-blank exercises provided as a hand-out. Each of these seven items had the same format (a sentence missing a word accompanied by a disambiguating picture and an abstract depiction of the force dynamic relationship). The class then went over the answers, which were shown as the final segment of the slide show.

For the Translation instruction, another slide presentation was created using the Apple Keynote program. The materials closely paralleled those of the FD condition, using parallel task sequencing and the same number of example

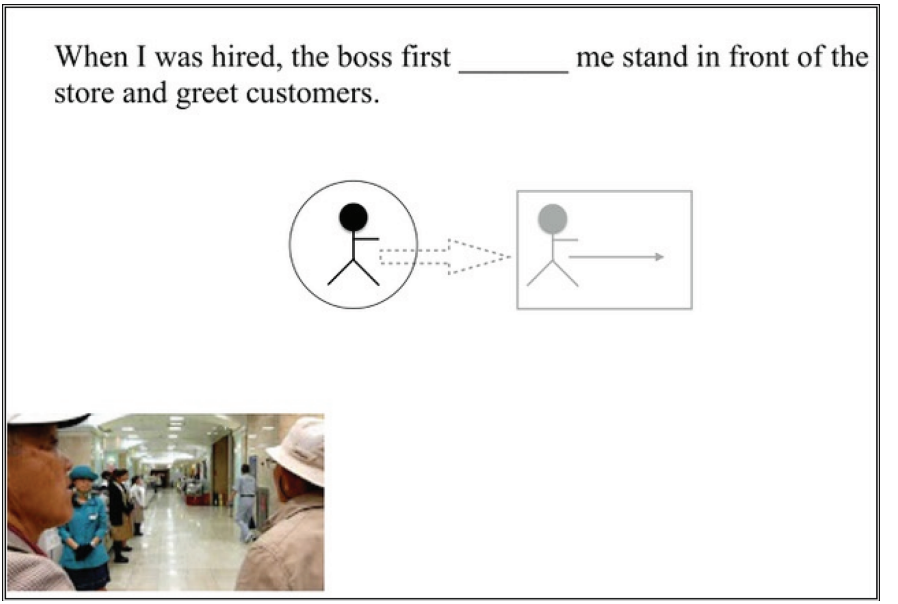

Figure 5: A review item targeting the verb *have* in the FD group's instruction.

sentences, which were all identical to those in the FD presentation. The materials for the Translation condition taught the target verbs via Japanese equivalents. For each verb, translations were provided showing the Japanese pattern (or patterns) that typically translate the verb along with the types of entities (e.g. person, things, etc.) that typically appeared as the subject or object within the target verb's syntactic frame. During this initial introduction of the target verbs, English example sentences were provided, followed by a very direct Japanese translation. As this translation was usually unnatural, it was followed by a more natural Japanese translation.

The direct translation demonstrated how the English target forms often had different constraints that prevented them from being consistently translated the same way in Japanese. For example, the English verb *make* is often translated using the Japanese causative -(*s*)*ase*; however, the English verb, unlike the Japanese causative, more freely allows for nonhuman agents (e.g. *The thought made him excited*) and, for this reason, when it occurs with an inanimate agent, it must be rendered differently in Japanese.

The final part of the presentation provided a summary of the Japanese translation patterns so that participants could match the Japanese patterns with their English equivalents. Then, in the practice phase, a set of slides with a

sentence missing one of the target force dynamic verbs was shown. Each slide was accompanied by a picture of the situation depicted by the sentence along with a natural Japanese translation. In other words, whereas the FD slides had a sentence, a disambiguating picture (to help participants understand the sentence), and an abstract animated graphic depicting the force dynamic relationship, the Translation group's slides replaced this abstract pictorial depiction with a Japanese translation.

In the Translation condition materials, a handout was again created with seven additional English sentences missing one of the seven target verbs. As in the Translation condition practice slides, each sentence (with the target verb missing) was paired with a natural Japanese translation and a picture showing the situation described by each sentence.

The experimental measures, used in all three of the current study's experiments, were multiple-choice tests. Three multiple-choice test forms were created and were counterbalanced so that a third of the Exp. 1 participants received each test form for the pretest, posttest, and delayed posttest. In Exp. 1, the test contained 22 items (three items for each of the target verbs and one filler item). Reliability of the test items was acceptable ($\alpha = 0.78$). To help participants better understand each sentence's intended meaning, each item was accompanied by a picture that corresponded to the situation described by the sentence. Due to the difficulty of creating items that allow for only one response, only six possible responses occurred for each item. Many items included a "none of the above" response to dissuade participants from arriving at the correct answer through a process of elimination. To ensure that participants would regard "none of the above" as a plausible answer, one filler item (excluded from all analyses) was included for which this was the correct response.

The verb-noun collocation patterns used in both the test and instructional materials were selected from the most commonly occurring patterns in the COCA Corpus (Davies 2008–) so as to make the instruction given to both groups maximally effective (for a discussion of why the pedagogical use of collocates distinctively associated with target forms may facilitate acquisition, see Ellis and Ferreira-Junior 2009; Goldberg 2006). The exact sentences and collocation patterns that appeared during the instructional phase did not appear on the multiple-choice tests. Because the target verbs could appear with either the bare infinitive (e.g. *made him go*) or with the infinitive (e.g. *forced him to go*), the six response choices included all the words following the target verb (for an example, see Figure 6). This was done to prevent participants from using the construction patterns (e.g. the presence of *from* or *to*) to deduce the correct answer.

I needed to go to the airport, so I…

a. forced the waiter to call a taxi.
b. had the waiter call a taxi.
c. helped the waiter call a taxi.
d. let the waiter call a taxi.
e. made the waiter call a taxi.
f. prevented the waiter from calling a taxi.

Figure 6: An example of an item from the multiple-choice tests used as measures in the two experiments.

To avoid the inclusion of participants who had very low proficiency (and could therefore not understand the test items or could not finish the test in time) as well as participants who did not take the tests seriously, participants scoring below 15% on any of the tests in the three experiments were excluded from all analyses. To avoid ceiling effects from the inclusion of participants who already had excellent understanding of the semantics of the target items, all data from participants who scored 85% or higher on the pretest (the cut-off recommended in Larson-Hall 2016: 363) were also excluded from all analyses. In both experiments, none of the tests were unannounced beforehand.

2.1.3 Procedure

Participants took a pretest one week prior to the instruction. The participants in both conditions were taught by the same Japanese instructor (the second author), and in both cases, the instruction lasted 70 minutes. The task sequences for the FD instruction are shown in Figure 7.

In the Translation condition, participants followed a similar procedure but with the focus on learning the target meanings through translation. In this condition, the instructor went over the Keynote slides for the Translation condition, going over both literal and more natural translations for each verb. At the end of the presentation, the instructor asked participants to match each of the typical Japanese patterns with the equivalent English target verb. Participants were then asked to work individually to fill in the blanks of seven sentences that were each missing one of the target verbs. The instructor then had participants compare their answers with a partner. The teacher then quizzed the class, asking them to state the English verbs that matched the Japanese patterns. After the

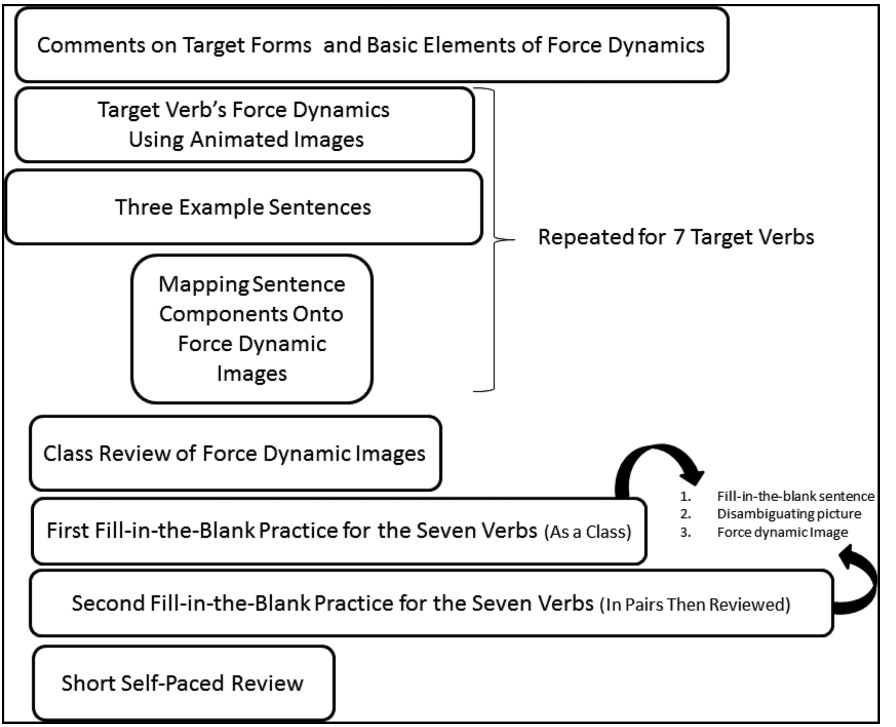

Figure 7: The task sequence for the FD group's instruction.

participants were finished, the instructor reviewed the items, calling on individual participants to share their answers. For each item, the instructor went over the sentence meaning in Japanese and discussed how the English verb was most appropriate as it best matched the Japanese translation. After this, participants were given several minutes to review the items.

The task sequencing for the Translation-Based group is shown in Figure 8. As with the FD instruction, participants did the first fill-in-the-blanks practice as a class and the second fill-in-the-blanks practice in pairs. The participants in both groups were exposed to five example sentences for each of the seven force dynamic verbs during the treatment phase and the time on task was the same for each key task and for instruction as a whole.

Participants were then given 20 minutes to complete the posttest. A delayed posttest was given three weeks later. The general sequences of Exp. 1 measures and instruction are shown in Figure 9.

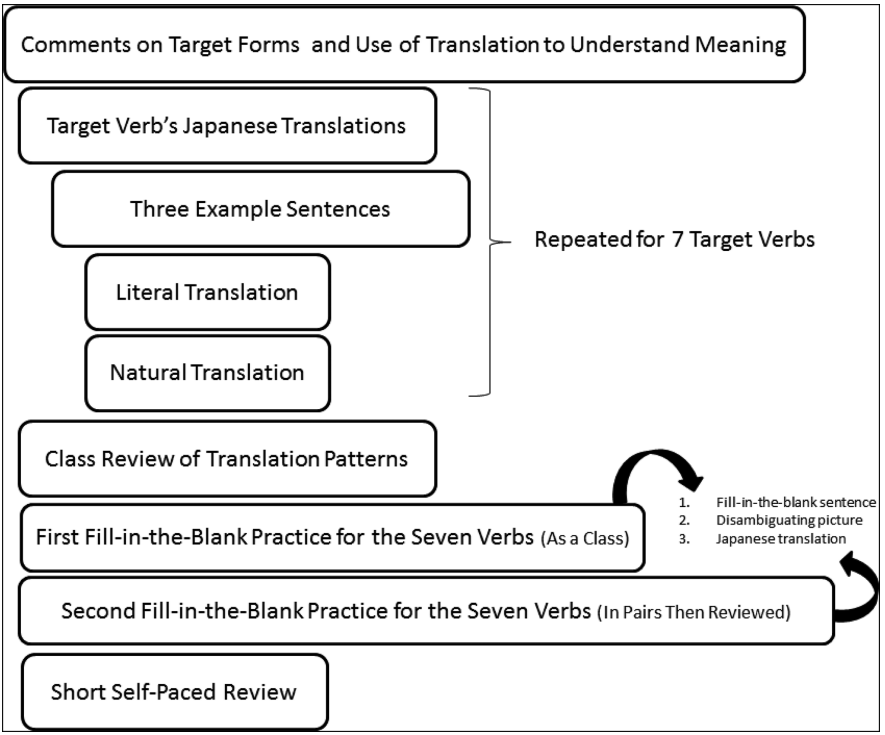

Figure 8: The task sequence for the Translation group's instruction.

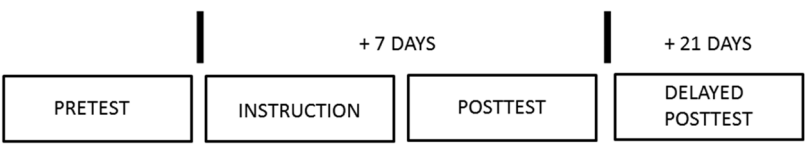

Figure 9: General sequences of measures and intervention in Exp. 1.

2.2 Experiment 1 results

The descriptive statistics for Exp. 1 are shown in Table 2.

As can be seen, the scores for both groups prior to instruction hovered around half the target items (16.7% correct was possible by guessing), suggesting that these force dynamic verbs are appropriate targets for instruction for the sampled population. The FD and Translation groups both demonstrated considerable

Table 2: Descriptive statistics for Exp. 1.

	FD Group ($n = 29$)		Translation Group ($n = 38$)	
	***M* (*SD*)**	**Range**	***M* (*SD*)**	**Range**
Pretest	9.3 (2.6)	4–16	10.9 (2.6)	4–17
Posttest	14.5 (3.6)	4–20	15.5 (2.9)	9–20
Delayed Posttest	12.7 (2.8)	7–18	13.6 (2.7)	8–19

learning, gaining 24.5% and 21.9% respectively on the posttest, and 16.0% and 12.6% respectively on the delayed posttest (relative to the pretest). The higher SDs among the FD group on the posttest suggest that the participants varied more in their ability to benefit from the FD instruction.

To determine participants' knowledge of the target verbs prior to the intervention, pretest scores for both groups were combined ($N = 67$) and analyzed in terms of accuracy on each verb. Keeping in mind that 16.7% accuracy is possible by guessing, the results, shown in Table 3, suggest that Japanese first-year EFL students experience considerable difficulty with the semantics of *have*, *get*, *let*, and *force*.

Table 3: Target verbs in Exp. 1 ordered according to participants' accuracy on pretest.

Target Verb	***M***	***SD***
help	61.3%	28.2%
prevent	57.6%	28.6%
make	54.9%	19.0%
force	39.9%	23.9%
let	31.0%	25.1%
get	26.6%	20.3%
have	25.5%	21.1%

A mixed within-between RM-ANOVA was conducted with Instructional Type as a between-subjects factor with two levels (FD and Translation) and Time as a within-subjects factor with three levels (Pretest, Posttest, and Delayed Posttest). The assumptions for an RM-ANOVA were met. Examination of the distribution of scores using box plots and Q-Q plots indicated that the data was normally distributed and that there were equal variances. The residuals had a normal distribution and equal variance. Mauchly's test, $\chi^2(2) = 0.72$, $p = 0.697$, and an

examination of covariances in the residual SS and cross-products matrix indicated that the assumption of sphericity had been met.

For the RM-ANOVA, a Type II sum of squares analysis was used, and the statistical analyses were conducted in SPSS Version 25. As would be expected, there was a significant effect of Time, $F(2, 130) = 62.56$, $p < 0.001$, partial $\eta^2 = 0.49$. There was also a significant effect of the between-subjects factor Instructional Type, $F(1, 65) = 5.71$, $p = 0.020$, $\eta^2 = 0.08$, largely reflecting the Translation group's higher scores on the pretest. A key interest in the current study was whether the FD instruction would produce an interaction between Time and Instructional Type, yet this interaction was not significant, $F(2, 130) = 0.34$, $p = 0.715$.

To determine whether the scores for each group were significantly different for the three different test times, separate paired-sample *t*-tests were conducted. These tests were all significant at an alpha of 0.05. The FD group's posttest scores were significantly higher than its pretest scores, $t(28) = 6.00$, $p < 0.001$, $d = 1.11$, as were the delayed posttest scores, $t(28) = 4.63$, $p < 0.001$, $d = 0.86$. As would be expected, its posttest scores were significantly higher than its delayed posttest scores, $t(28) = 2.65$, $p = 0.013$, $d = 0.49$. Likewise, the Translation group's posttest scores were significantly higher than its pretest scores, $t(37) = 9.89$, $p < 0.001$, $d = 1.60$, as were its delayed posttest scores, $t(37) = 5.53$, $p < 0.001$, $d = 0.90$. Moreover, its posttest scores were significantly higher than its delayed posttest scores, $t(37) = 4.00$, $p = 0.002$, $d = 0.65$.

3 Experiment 2

In Exp. 1, the group receiving force dynamic (FD) explanations based on the Cognitive Linguistics (CL) framework achieved gains that were quantitatively slightly higher than the group receiving translation-based instruction, but the FD group failed to show a clear advantage. This was unexpected as previous research (e.g. Tyler et al. 2010) has demonstrated that FD explanations of L2 semantics lead to more learning relative to a conventional approach. One possible explanation for this outcome relates to participants' familiarity with both instructional approaches. Whereas the Exp. 1 participants are undoubtedly familiar with the use of translation to convey L2 semantics, the FD lesson was probably the FD group's first exposure to such explanations and the use of animated figures to convey L2 semantics. In fact, some participants in the FD group, when doing the second fill-in-the-blank practice for the seven verbs (a pair-work task), were overheard discussing the L1 translation of the target items as they completed the task.

3.1 Experiment 2 method

For the above-mentioned reasons, Exp. 2 repeated the first experiment's procedure using a slightly altered instructional format designed to ensure that participants in the FD condition did not revert to reliance on L1 translation equivalents as they were doing the FD treatment tasks. Specifically, the second fill-in-the-blank exercises (the penultimate tasks in Figures 7 and 8) were still done in pairs, but participants, as a class, were asked about their answer immediately after completing each item. Instead of simply providing an answer, participants in the FD condition had to methodically go through the force dynamic configuration, describing the predilection of the antagonist, the strength of the force, the predilection of the agonist, and the outcome. When providing answers, participants chose from various possibilities (represented using the animated images) on a Keynote slide. After they determined the correct choice, the incorrect choices disappeared from the screen, and they went on to the next element. After all the elements in the force dynamic configuration were selected, the participants were asked which force dynamic verb best described that configuration. The format for the Translation group was similarly changed, but the participants, instead of mapping the English sentence in each item onto animated diagrams, mapped each element onto Japanese translations, after which they were asked to select the best force dynamic verb.

The expansion of the penultimate tasks from Exp. 1 in both sets of instruction made the Exp. 2 materials longer. To ensure that the materials could be completed, along with the pretest, in a single 90-minute class period, the target verbs in Exp. 2 were reduced to five (i. e. *force, get, have, let*, and *make*). *Help* and *prevent* were removed as these were found to be the easiest of the seven verbs in Exp. 1. The same test forms were used as in Exp. 1 but with the *help* and *prevent* items removed and an extra item (taken from the Exp. 1 Form C test) for each of the target verbs added ($\alpha = 0.83$). There were therefore 20 items (four per target verb) and one distractor (for which "none of the above" was the correct answer), which was excluded from the analysis. Exp. 1 showed the test forms to be roughly equivalent, so instead of counterbalancing test forms, the new Form A was used for the pretest, and the new Form B for the posttest. The experimental procedure, much like that of Exp. 1, involved a 15-minute pretest followed by 70 minutes of instruction. An unannounced posttest was given three weeks later.

The participants ($N = 97$) were from two intact first-year required English classes at a large public university in Japan. With slightly higher proficiency than the participants of Exp. 1, they could be described as roughly at the B1 level of the CEFR. One class ($n = 52$) was randomly assigned to the FD condition, and

the other ($n = 45$), to the Translation Condition. A Japanese native instructor (the second author) taught both classes.

To avoid inclusion of participants who had very low proficiency as well as participants who did not take the tests seriously, participants scoring below 15% on any of the tests in the three experiments were excluded from all analyses. To avoid ceiling effects from the inclusion of participants who already had excellent understanding of the semantics of the target items, all data from participants who scored 85% or higher on the pretest were also excluded from all analyses.

3.2 Experiment 2 results

The descriptive statistics for the pretest and posttest are shown in Table 4. It should be noted that the posttest, like the *delayed* posttest of Exp. 1, was given three weeks following the treatment.

Table 4: Descriptive results for Exp. 2.

FD Group		Translation Group	
Pretest *M* (*SD*) Range	Posttest *M* (*SD*) Range	Pretest *M* (*SD*) Range	Posttest *M* (*SD*) Range
12.0 (3.0) 2–16	13.5 (2.8) 8–19	12.0 (3.0) 3–16	13.0 (3.2) 3–20

As can be seen, the pretest scores and pretest *SD*s happened to be identical for the two groups. On the posttest, the FD group achieved a 7.5% improvement compared with a 5% improvement for the Translation group. To determine whether the scores of the FD group were significantly higher than those of the Translation group, a mixed within-between RM-ANOVA was conducted in SPSS. Time was treated as a within-subjects factor with two levels (Pretest and Posttest), and Instructional Type was treated as a between-subjects factor with two levels (FD and Translation). The assumptions for an RM-ANOVA were met. Examination of the distribution of scores indicated that the data was normally distributed and that there were equal variances. The residuals had a normal distribution and equal variance. All effects are reported as significant at $p = 0.05$. There was a significant main effect of Time, $F(1, 95) = 12.40$, $p = 0.001$. There was no significant effect of Instructional Type, $F(1, 95) = 0.25$, $p = 0.618$, and the interaction between Instructional Type and Time was also

nonsignificant, $F(1, 95) = 0.708$, $p = 0.402$. Experiment 2 suggests that the FD and translation instructional approaches lead to similar gains even when the FD instruction is modified to ensure that learners focus consistently on the FD explanation and force dynamic images.

4 Experiment 3

Exp. 1 and Exp. 2 showed that instruction based on force dynamics resulted in both immediate and lasting learning, and that it was as effective as translation-based instruction. One possible explanation for the FD instruction's effectiveness could be its use of images. Baddeley's (1986) influential model of working memory assumes, as key components, the phonological loop and the visuospatial sketchpad: two working memory stores believed to have limited capacity. Based on this view of working memory, some researchers have argued that learning is enhanced when pictorial and verbal information are presented simultaneously (Clark and Paivio 1991; Mayer and Moreno 1998). To determine whether pictorial information was an essential component of FD explanations, the third experiment compared the effectiveness of FD instruction employing animated images (as in the FD condition in Exp. 1 and Exp. 2) with FD instruction that did not use images.

4.1 Experiment 3 method

The participants in Exp. 3 ($N = 54$) came from two intact first-year required English classes at a large public university in Japan. With proficiency similar to that of the participants of Exp. 2, they could be described as roughly at the B1 level of the CEFR. One class ($n = 33$) was randomly assigned to the Imagery condition and the other class ($n = 21$) to the No Imagery condition.

The Imagery group's instruction was identical to that of the FD Group in Exp. 1. The No Imagery group's instruction was also identical except that the depictions of force dynamic relationships were not depicted pictorially and were instead only explained in words. The procedure was identical to that followed by the FD group in Exp. 1 except that a delayed posttest was not given due to time constraints. As in Exp. 1, the instruction was provided by a Japanese native speaker (the second author). The tests and the seven target items were the same as those used in Exp. 1 except that the test forms, having been found to be equivalent, were not counterbalanced. Instead, test Form A was used for the pretest, and Form B was used for the posttest. As in Exp. 1, one week after

participants took the pretest, they received the treatment and then completed the posttest. Unlike Exp. 1, there was no delayed posttest.

4.2 Experiment 3 results

The descriptive statistics for Exp. 3 are shown in Table 5.

Table 5: Descriptive results for Exp. 3.

	Imagery Group		No Imagery Group	
	M (*SD*)	Range	*M* (*SD*)	Range
Pretest	12.1 (3.1)	4–17	11.5 (3.1)	6–17
Posttest	16.8 (2.3)	11–21	17.1 (2.5)	12–20

As can be seen, the participants of Exp. 3 relative to those in Exp. 1, had slightly higher scores on the pretest, yet still demonstrated poor initial understanding of the target forms. On the posttest, which was given immediately following instruction, both groups showed considerable gains (22.5% for the Imagery group and 26.5% for the No Imagery group). The gains for both groups are virtually identical to those of the FD group in Exp. 1. The instructional benefits were quite consistent, with only three participants from the Imagery group and one participant from the No Imagery group failing to show gains on the posttest.

To determine whether the No Imagery group's slightly greater gains were significantly higher than those of the Imagery group, a mixed within-between RM-ANOVA was conducted with Instructional Type as a between-subjects factor with two levels (Imagery and No Imagery), and Time as a within-subjects factor with two levels (Pretest and Posttest). The assumptions for an RM-ANOVA were met. Examination of data distributions indicated that the data was normally distributed and that there were equal variances. The residuals had a normal distribution and equal variance.

For the RM-ANOVA, a Type II sum of squares analysis was used, and the statistical analyses were conducted in SPSS. As would be expected, there was a significant effect of Time, $F(1, 52) = 113.26$, $p < 0.001$, partial $\eta^2 = 0.69$. The effect of Instructional Type was not significant, $F(1, 52) = 0.06$, $p = 0.807$. The interaction between Time and Instructional Type was also not significant, $F(1, 52) = 0.75$, $p = 0.390$.

Statistics were then conducted to determine whether both groups of participants showed significant learning. A paired samples *t*-test on the Imagery group's scores showed that the posttest scores were significantly higher than their pretest

scores, $t(32) = 7.71$, $p < 0.001$, $d = 1.34$. Likewise, a paired samples t-test on the No Imagery group's scores showed that their posttest scores ($M = 17.1$, $SD = 2.5$) were significantly higher than their pretest scores ($M = 11.5$, $SD = 3.1$), $t(32) = 7.41$, $p < 0.001$, $d = 1.62$.

5 Discussion

The three experiments of the current research show that a lesson on force dynamic verbs using a force dynamics (FD) explanation leads to extensive gains that are maintained over a three-week period. Based on the Exp. 3 results, the FD instruction's effectiveness does not appear to rely on its use of animated images. Unlike previous research which has found advantages for pedagogical explanations based on the Cognitive Linguistic framework over conventional approaches and for FD descriptions specifically (e. g. Tyler et al. 2010), the current study did not find evidence that the FD instruction is more effective than conventional instruction, operationalized, in this case, as instruction that teaches the L2 semantics through L1 translation.

It should be noted that the FD groups in all three experiments showed consistently high gains, with effect sizes very similar to those found generally for explicit instruction in previous research (e.g. the studies in the Goo et al. 2015, meta-analysis). That said, several factors may collude to reduce the effectiveness of the FD instruction in the current study so that it did not show a significant advantage over conventional instruction based on translation.

First, the FD presentation involved the introduction of a highly novel perspective on language. Some linguistically naïve learners may have found it difficult to conceptualize force dynamic concepts apart from the L1 words typically used to express those concepts. As a result, some of the instructional time had to be allotted to introducing basic concepts related to force dynamics (e.g. the concept of an agonist, antagonist, and so on). While this introduction was a necessary prerequisite to the FD treatment, the time spent covering basic concepts within the FD framework reduced the time available to focus on the specific semantics of each target verb.

The translation condition, on the other hand, involved a highly familiar strategy for learning the semantics of L2 words and grammar. In a sense, translation may be viewed as a common default strategy in L2A. Evidence for this interpretation of the results comes from several participants' comments while doing pair-work in Exp. 1. Although the participants were in the FD condition, they could be overheard discussing the target semantics in terms of L1 translation equivalents (cf. Masuda and Labarca 2015).

In light of such observations, the FD instruction may have been more effective if it had been presented within a curriculum that had consistently provided instruction based on a Cognitive Linguistics framework. One could imagine, for example, a course of study in which multiple linguistic targets are taught using CL-based explanations of force dynamics or other schema-based explanations (cf. Tyler et al. 2010, Tyler et al. 2011). In such a curriculum, some of the costs in time incurred by explaining novel linguistic conceptualizations may eventually prove a sound investment as students re-apply the conceptualizations to target forms encountered in subsequent lessons. Consider, for example, the key concepts underlying CL force dynamic explanations. These could be initially introduced to teach the distinctive features of verbs such as *make*, *let*, and *have*, and then later be reintroduced when teaching the fine-grained distinctions between modals such as *must*, *should*, and *might*.

The Exp. 3 results showing equal effectiveness for instruction using pictorial elements and instruction devoid of such elements is surprising. Once more, it could be that the advantages of such elements are offset by the cost in time, as the representational significance of the diagrams must be explained to the learners.

The current research has several important limitations. It must be noted that the measure employed in the three experiments (a standard multiple-choice test) did not involve time pressure and as a result, scores reflect, in part, participants' explicit knowledge, including metalinguistic knowledge. Participants receiving such a test are essentially being prompted to recall the related period of instruction and use recalled information as the basis for selecting answers. Since the primary concern with research on L2 pedagogy should be how instruction influences L2 learners' communicative competence (i.e. the ability to deal with real-world tasks involving the L2), future research should ideally involve multiple measures to determine the extent to which CL-based treatments result in the development of both implicit and explicit knowledge, and in the case of longer interventions, the extent to which the L2 knowledge is automatized (for a relevant theoretical discussion, see R. Ellis 2015; Suzuki and DeKeyser 2017).

In addition, the research examined only Japanese-L1 learners at a specific stage of acquisition. It should thus not be construed as applying to learners across all levels of proficiency. Moreover, the participants were EFL learners with little L2 input outside of classes. It could be that learners in a more input-rich environment would exhibit different patterns of learning, perhaps benefitting from more encounters with the target forms incidentally in input subsequent to the explicit instruction.

Viewed broadly, the current results support the use of force dynamic explanations. In purely quantitative terms, the FD groups in the current study achieved gains that were consistently numerically higher than those of the comparison

groups, although the small advantage for FD instruction never approached statistical significance. The FD instruction may have additional benefits, untested in this study, if it enables learners to think about language using abstract concepts not bound to the L1. In the future, further research is needed to examine the specific type of learning (e.g. implicit vs. explicit) produced by CL treatments. The slightly greater SDs for the FD group on the Exp. 1 posttest are also suggestive. It could be that specific learners are better able to take advantage of FD explanations. If this is the case, future researchers may also want to examine treatment-aptitude interactions.

Researchers should also further explore the conditions in which imagery like that used in the current experiments is beneficial. One possible interpretation of the Exp. 3 results is that the benefits of imagery in shorter instructional sessions is offset by the time required to familiarize learners with the mappings from the images to the abstract target semantics. Whether this is, in fact, the case could be determined through the introduction of an additional independent variable (i.e. Length of Treatment) to an experiment (like the current Exp. 3) comparing the effects of treatments with and without imagery.

Another pedagogical option, suggested by one of the reviewers, would be to combine FD explanations with a translation-based approach. Although translation is often disparaged due to its associations with outmoded SLA pedagogies, it does provide straightforward means of conveying L2 semantics. When using translation in isolation, there is a risk that L2 learners will assimilate the L2 force dynamic verbs into L1 categories while ignoring the ways in which the L1 and L2 categories differ. By combining the two approaches, this risk can perhaps be reduced. The effectiveness of such a combined approach should be investigated in future research.

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