Multi-cognition in L2 users:
More evidence from an object categorization task
by Japanese elementary school children*

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Abstract

This study examines whether early limited exposure to a second language (L2) influences cognition of child L2 users. Research evidence, particularly from a ‘bilingual cognition’ perspective, has shown that knowledge of a L2 has effects on adult L2 users’ cognitive dispositions as well as their first language. However, there remains an issue of the timing of L2 learning influence on cognition. A picture categorization task was given to three groups of Japanese elementary school children with different amounts of English exposure. The purpose was to see how much exposure is necessary for L2 users to modify their object categorization preferences. It was found that though Japanese child L2 users fundamentally categorized objects based on the syntagmatic-thematic relation, the proportion of paradigmatic-taxonomic categorization steadily increased according to the cumulative amount of exposure. Response times also became faster. These findings accorded with those found in previous categorization studies with advanced adult L2 users. It was concluded that the findings in the present study provide further evidence of the early emergence of ‘multi-cognition’, a state of mind with more than one cognitive apparatus in L2 children. This reflects the very early effects of L2 exposure on cognitive dispositions.

1. Introduction

There is now an increasing body of research evidence that shows second language (L2) users’ linguistic competence qualitatively differs in some way from that of both the first language (L1) and the target language monolinguals (Tokumaru, 2002; Cook et. al., 2003; Murphy & Pine, 2003). This unique competence, a compound state of mind with more than one language (i.e., their L1 and interlanguage), has been called ‘multi-competence’ after Cook

* This study was supported in part by the Japan Ministry of Education, Culture, Sports, Science and Technology Grant-in-Aid for Scientific Research (#20520549).
Second language acquisition (SLA) and other related research has also shown that not only L2 users’ linguistic competence but also their cognitive dispositions such as color categorizations (Athanasopoulos et al., 2004; Athanasopoulos, 2009), shape-substance distinctions (Cook et al., 2006; Kasai & Takahashi, 2005) and categorizations of thematic-taxonomic relations (Murahata & Murahata, 2007) somehow differ from those of either L1 or L2 monolinguals (see Jarvis & Pavlenko (2008) and Cook & Bassetti (to appear) for a comprehensive literature review). As Figure 1 below shows, Murahata (2010) called this L2 users’ unique cognition ‘multi-cognition’, which referred to a compound state of L2 users’ mind with L1-established cognition and ‘inter-cognition’ (Cook, 2008, p. 21). Existing evidence for multi-competence and multi-cognition, however, has been exclusively based on the results of those studies which used advanced adult L2 users as participants. Hence little is known about the influence of L2 learning on incipient child L2 users’ competence and cognitive dispositions.

![Diagram of multi-cognition](image)

Figure 1. Multi-cognition (Murahata, 2010)

Studies on cognitive and developmental psychology have shown strong early effects of language (L1) on cognition (Choi and Bowerman, 1991; Choi, 1997; Imai & Gentner, 1997; Choi et al., 1999). For example, Choi et al. (1999) examined young children’s comprehension of spatial terms in and kkita in two languages (English and Korean) to explore the timing of sensitivity to language-specific concepts with a cross-linguistic design. These terms strikingly differ in concepts of space in that the Korean verb kkita refers to actions resulting in a tight-fit relation regardless of containment or support while English makes a distinction between actions resulting in containment (put in) versus support or surface attachment (put on). They found that when they saw scenes with those terms even 18-to-23 month years old children gazed at different and language-specific aspects of the scenes. Choi et al. (1999) concluded that
children’s comprehension of those terms was guided by language-specific concepts realized by their L1 (p. 263).

This early sensitivity to the relationship between language and concepts strongly implies a latent possibility of early L2 learning influence on L2 child users’ cognition. Thus, the present study is an attempt to find further evidence for ‘multi-cognition’ in child L2 users of extremely limited L2 exposure with special focus on a cognitive process ‘categorization’. ‘Categorization’ was chosen as focus of research because there is nothing more basic than ‘categorization’ to our cognitive activities (Lakoff, 1987, pp. 5-6). Then, as Markman (1989, p. 11) says, it is a fundamental cognitive process, involved in one way or another in almost any intellectual endeavor. For instance, in identifying objects, in perceiving two things as similar, in acquiring and using language, in all of these cognitive processes, categorization plays a major role.

2. Review of relevant studies

2.1 Terminology

Studies related to ‘categorization’, according to Smiley and Brown (1979), there are two distinctive types of categorization. One type is based on how things are used or related to the real world. Things in this category have a linear character. For example, ‘monkey’ and ‘banana’ are linearly related because of their ‘thematic’ relation: for example, ‘Monkeys love bananas.’ The other type is based on how things are associated or related with each other. Thus, things in this category have the common character: for example, ‘monkey’ and ‘panda’ are related categorically because they are both animals. Smiley and Brown (1979) called this the ‘taxonomic’ relation.

However, the pairs of syntagmatic-paradigmatic and thematic-taxonomic have been used rather interchangeably in difference contexts of linguistics and SLA research literature. For example, according to linguists such as de Saussure (1916), in categorizing or relating objects around us as part of our mental activity, we use two different kinds of linguistic relations. One has been called the ‘syntagmatic’ relation, which has the linear character of linguistic items such as Dieu est bon (‘God is good’) (de Saussure, 1916, p. 170). The other ‘associative’ relation does not address such a linear character but rather a common character of linguistic items that form groups of variously related members. These terms have been used in object categorization or word association research (Ervin, 1961; Yoneoka, 1987; Wolter, 2001).

Other different terms have also been used to distinguish between pairs of dichotomized relations referred to in different research contexts such as:

- relational-contextual/descriptive-analytic, descriptive-whole/inferential-category (Chiu, 1972)
- functional/conceptual (Moran, Mefford & Kimble, 1964)
- iconic, enactive/functional, logical (Moran, 1973)

All of these pairs, however, share a general idea that the former denotes the organization of objects based on how they are used or their relationships with the real world (functional, thematic, complementary, syntagmatic relations) while the latter denotes the organization of objects based on how they are associated or their relationships with each other (associative, taxonomic, paradigmatic relations) (Smiley & Brown, 1979, p. 250). Thus, in this study the compound terms ‘SynThem’ and ‘ParaTax’ respectively are used to subsume diverse terminology in the literature (Murahata, to appear).

2.2 Background to concept research: categorizing objects and word association

There have been two different lines of concept research in the field of developmental psychology: categorizing objects and word association. Though research studies along these lines have been conducted in different arenas with different research methods, they keep track of the same concern, that is, how words and concepts are organized in the mind or in the mental lexicon (Smiley & Brown, 1979, p. 250). For example, cognitive psychologists from the word association tradition hold the view that associative responses to stimulus words reflect the functioning of concept and thought processes of an individual (Zareva, 2007, p. 124). In the sections that follow we will briefly review some of the main findings in those concept research studies which seem relevant to the present study.

2.2.1 Categorizing objects by monolinguals and L2 users

As for categorizing objects by monolinguals, it has been shown that young children prefer categorizations based on the SynThem relation while mature monolinguals prefer categorizations more based on the ParaTax relation (Ervin, 1961; Smiley & Brown, 1979). This change of categorization preference has been called the thematic-taxonomic (SynThem-ParaTax) shift (Entwisle et al., 1964). For example, Smiley and Brown (1979) explored the shift by using a picture matching task where participants were given a standard picture and two other pictures, either thematically related or taxonomically related, and were asked which of the two pictures went best with the standard word. They found that the higher the participants’ ages, the clearer the shift from SynThem to ParaTax categorization preferences they showed.

Chiu (1972) conducted a cross-linguistic study to see how monolingual children of different linguistic backgrounds categorize objects. They were given an object selection task where Chinese- and English-speaking participants were asked to select any two out of the three objects in a set which were alike or went together. It was found that Chinese children preferred to select objects on the basis of the SynThem relation, while American children on the basis of
the ParaTax relation. This finding was of importance in that the ParaTax preference for categorizing objects cannot be universally manifested in all groups of older ages as often depicted as the SynThem-ParaTax shift, and also that the language of children could possibly influence their categorization preference patterns.

From a socio-psychological perspective, Ji et al. (2002) examined how adults from different linguistic (cultural) backgrounds categorize objects in order to see a linguistic (cultural) influence on categorizing objects. They presented monolingual English and Chinese college students with triads of SynThem and ParaTax relations (‘Cow’ [the standard], ‘Milk’ [the SynThem relation to the standard], ‘Panda’ [the ParaTax relation to the standard]) and asked them to decide which went best with the standard. The results revealed that English monolinguals showed a marked preference for categorization on the basis of ParaTax, while Chinese monolinguals showed a preference for categorization on the basis of SynThem. This finding was well in accordance with the finding by Chiu (1972) for a possible linguistic influence on object categorization.

Murahata and Murahata (2007) conducted a cross-linguistic experiment by replicating the data collecting method used in Ji et al. (2002). Participants were Japanese adult users of English with different levels of English proficiency and English monolinguals. They were asked to judge how strong the relations between ParaTax objects and SynThem objects were. They found that English monolinguals judged ParaTax relations to be more strongly than Japanese users of English, and that advanced Japanese L2 users judged ParaTax relations more strongly than less advanced Japanese L2 users.

2.2.2 Word association by monolinguals and L2 users

The other line of concept research concerns what word come to mind when people are given a word as stimulus. Wakabayashi (1973) examined word associations by Japanese monolinguals and English monolinguals. He found a substantial difference between the two groups. While the English monolinguals overwhelmingly produced ParaTax associations, the Japanese counterparts produced much more SynThem associations than English monolinguals. Though Wakabayashi himself did not suggest a linguistic influence on word association preferences, his result coincided with the findings in the case of categorizing objects.

Reviewing a series of his own and associates’ research into word associations by Japanese speakers of different ages, Kashu (1973) found no straight SynThem-ParaTax shift in Japanese speakers as often been observed among English speakers such as Smiley and Brown (1979). Japanese speakers were more likely to make SynThem associations across all age groups. Moreover, the proportion of ParaTax associations further decreased as their ages went higher. This finding was replicated in several word association experiments by Araki (1995).

Moran (1973) longitudinally examined cross-linguistic differences in the growth of cognitive dictionaries between young Japanese and American children by using a free word
association task. He found a marked shift from SynThem to ParaTax associations among American children as they grew older. This clearly supported Ervin’s (1961) finding that English-speaking children of increasing ages showed marked increases in ParaTax responses. On the other hand, a reverse pattern of association preferences was found in Japanese children. They showed an overwhelming preference for SynThem associations with increasing frequency as they grew older. Moran’s (1973) findings show that the preference changes the SynThem-ParaTax shift for American children and no preference shift (i.e., the SynThem-SynThem shift) for Japanese children. This suggests a theoretical consequence for the growth of monolingual children’s cognitive dictionaries that there may be a universal preference modification pattern of word associations in young children. In other words, children first organize words in their mental lexicon based on the SynThem relation and later modify or stay with its organization as a consequence of acquiring their L1.

As for word association by bilinguals, Yoneoka (1987) tried to replicate Moran’s (1973) finding of the SynThem-ParaTax shift among English and Japanese speakers of different ages. She found a clear shift in the association patterns among English speakers, from SynThem in young children to ParaTax in adults. On the other hand, Japanese speakers’ responses did not show a general SynThem-ParaTax shift. This supported Moran’s (1973) finding.

The findings in the studies above related to concept development or change, either by monolinguals or bilinguals, hold two implications. Firstly, young children overwhelmingly categorize lexical items or concepts in the mind based on the SynThem relation. Then later as they grow older they seem to modify their categorical preference patterns to either the ParaTax or SynThem relation depending on the language they are exposed to as their L1. In the case of Japanese monolinguals, they first categorize objects based on the SynThem relation and even as they grow older they are still likely to categorize objects in fundamentally the same way based on the SynThem relation. One the other hand, English monolinguals come to categorize objects based more on the ParaTax relation as they grow older. Secondly, this L1-influenced categorization preference could again be modified by exposure to another language. For example, Japanese adult users of English came to categorize objects based more on the ParaTax relation as their L2 proficiency went higher.

3. The study

3.1 Research questions

There are three research questions in the present study. The first two are related to cognitive processes, the object categorization either based on the SynThem or ParaTax relation, and the third is related to the period of time taken for each response and cognitive processing:
1) Do Japanese child L2 users basically categorize objects based on the SynThem relation as often found in previous studies?

2) Does L2 exposure influence the way incipient child L2 users categorize objects?

3) Are there any differences in response times between groups of different amounts of L2 exposure?

The first question is to see if the SynThem categorization preference can also be found in child L2 users. The second question concerns whether or not as English exposure increases such children shift their categorical preferences, say, categorize objects based more on the ParaTax relation as English monolinguals do. The third research question asks about any differences in response times between groups of different amounts of L2 exposure. Hunt and Agnoli (1991) hold that examining ‘current practice’ is one of the best ways to determine cross-linguistic effects on cognition as psychologists and psycholinguists often study differences in the time required to perform a certain task. Moreover, as Cook (1997) concluded after reviewing several empirical studies, “L2 users are less effective in speed of processing” (p. 289) languages, either L1 or L2. Thus we can predict that children with more L2 exposure respond slower than those with little L2 exposure.

3.2 Participants

Participants of the present study were 76 children, 5th and 6th graders (10 to 11 year-olds), from two elementary schools, K-ES and S-ES. Both schools are located in central cities of a Western prefecture in Japan. Thus, little difference exists in socio-economic backgrounds between the children from the two elementary schools. However, at the time of the experiment, the children at K-ES received no formal English teaching. On the other hand, the children at S-ES had been receiving two hours a week English teaching from the 3rd grade. In English class children engage in a variety of language activities by Japanese teachers of English (JTEs), who received formal teacher training at a national university and are qualified as English teachers. They try to use English most of the time during the class. S-ES also has a full-time ALT who helps those JTEs by team teaching. Some children at S-ES had also learned English outside of school for more than one year.

The participants were divided into three groups according to the amount of English exposure. The Non-EX group (K-ES children) consists of 26 children with no formal English learning at school and outside of school; the EX group (S-ES children), 32 with two hours a week English learning at school but no English learning or less-than-one-year English learning outside of school; the EX-EX group (S-ES children), 18 with two hours a week English learning at school and more-than-a-year English learning outside of school.
3.3 The task

A picture categorization (or matching) task after Smiley & Brown (1979) and Ji et al. (2002) was given to the participants. There were three different entity types: Animals, Daily goods and Vehicles, and four trials for each entity type, which make up 12 trials in total. In each trial, three pictures were given as stimuli: the standard stimulus, the SynThem stimulus, and the ParaTax stimulus. Figure 2 below shows an Animal entity trial. The monkey on top is the standard stimulus, the banana bottom left the SynThem stimulus, and the panda bottom right the ParaTax stimulus.

Table 1 shows all the stimuli for the 12 trials used in the present study.

<table>
<thead>
<tr>
<th>Entity Types</th>
<th>Standard</th>
<th>SynThem</th>
<th>ParaTax</th>
</tr>
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<tbody>
<tr>
<td>Animals</td>
<td>Monkey</td>
<td>Banana</td>
<td>Panda</td>
</tr>
<tr>
<td></td>
<td>Cow</td>
<td>Milk</td>
<td>Sheep</td>
</tr>
<tr>
<td></td>
<td>Camel</td>
<td>Horse</td>
<td>Desert</td>
</tr>
<tr>
<td></td>
<td>Fish</td>
<td>Crab</td>
<td>Fishing-rod</td>
</tr>
<tr>
<td>Daily Goods</td>
<td>Pencil</td>
<td>Notebook</td>
<td>Pen</td>
</tr>
<tr>
<td></td>
<td>Fork</td>
<td>Salad</td>
<td>Chopsticks</td>
</tr>
<tr>
<td></td>
<td>Ring</td>
<td>Wedding</td>
<td>Necklace</td>
</tr>
<tr>
<td></td>
<td>Piano</td>
<td>Notes</td>
<td>Violin</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Train</td>
<td>Railroad</td>
<td>Bus</td>
</tr>
<tr>
<td></td>
<td>Truck</td>
<td>Logs</td>
<td>Taxi</td>
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<tr>
<td></td>
<td>Car</td>
<td>Road</td>
<td>Bicycle</td>
</tr>
<tr>
<td></td>
<td>Airplane</td>
<td>Clouds</td>
<td>Helicopter</td>
</tr>
</tbody>
</table>
These 12 trials were randomly given to the participants. As shown in Figure 3, first each participant was given the standard picture (stimulus) alone and then was shown two more pictures (the SynThem stimulus and the ParaTax stimulus) in circles below the standard stimulus. Then they were to decide which stimulus best went with the standard stimulus. On deciding, the participant was required to say in Japanese, ‘Kocchi (This one)’, with their finger pointing to either of the alternative stimuli.

Figure 3. The ‘object categorization’ experiment

The time-recorder beside the experimenter measured the length of time taken for each of the responses, that is, from the time when the participant saw the two pictures in circles to the time when he or she pointed to one of the pictures. A time-keeping software called SGwatch (© 2005 Still Green) was used to measure the length of time.

4. Results and discussion

To find the answer to the first research question, that is, whether Japanese child L2 users basically categorize objects based on the SynThem relation as often found in previous studies, the means of the two response types (SynThem and ParaTax) for all the participants (N=72) were calculated. Figure 4 shows its results. There was a large difference between the means of the two response types. The mean of the SynThem response was 2.93 (SD=1.23; Max=4.00 [4 trials]) while the mean of the ParaTax response was 1.07 (SD=1.231). Nearly three quarters (73.3% [2.93/4.00]) of the Japanese children’s categorization responses were based on the SynThem relation. A t-test was performed on the data and the difference between the two response types was statistically significant ($t(227) = 11.429, p < .000$ (two-tailed)). Therefore, the answer to the first research question was positive in that Japanese children overwhelmingly prefer to categorize objects based on the SynThem relation.
Secondly, the means of the two response types for each of the three groups were calculated to examine if there were any differences between groups of different amounts of L2 exposure. That is, is it possible to find any L2 exposure effects on categorization preferences in child L2 users? Figure 5 shows group means of SynThem and ParaTax responses. As you can see, the proportions of SynThem responses (grey bars) constantly declined while those of ParaTax responses (black bars) rose. Particularly important was the large gap between the non-EX group and the EX and EX-EX groups. The means of the ParaTax relation for the latter groups (1.15 and 1.61) was nearly twice or three times as large as that for the non-EX group (0.59). Statistical analyses (ANOVA) also showed significant differences between the two categorical types ($F(1, 73) = 59.532, p < .000$) and the interaction between group and categorical type ($F(2, 73) =$ ...)
6.103, \( p < .004 \)). These results are evidently an indication of L2 learning influence on child L2 users’ objects categorization. That is, as a consequence of learning a L2, Japanese children gradually shifted their object categorization preference patterns from the SynThem relation to the ParaTax relation.

The third research question was whether or not there are any differences in response times between groups of different amounts of L2 exposure. Behind this question is a psychological premise that one of the best ways to determine cross-linguistic effects on cognition is to measure differences in the time required to perform a certain task (Hunt & Agnoli, 1991). Table 2 and Figure 6 show group means of response times (seconds) for each of the three groups.

| Table 2. Group means (SDs) of response times (seconds) |
|---------------------------------|---|---|---|
|                                | Non-EX (N=26) | EX (N=32) | EX-EX (N=18) |
| Means                          | 2.331         | 1.982      | 1.813         |
| SD                             | 1.816         | 1.023      | 0.957         |

![Figure 6. Group means of response times (seconds)](image)

As you can see in Figure 6, there are clear differences in response times between groups. To our great surprise, the response times became faster as L2 exposure increased (2.331 seconds for the Non-EX group, 1.982 seconds for the EX group, 1.813 seconds for the EX-EX group) contrary to our prediction. One-way ANOVA was performed on the data and the result was statistically significant (\( F(2, 73) = 10.760, p < .000 \)). Furthermore, t-tests were performed on the data to see differences between groups. As the t-test (two-tailed) values in Table 3 show, all of the pairs between the three groups were statistically significant, indicating clear differences
in response times between groups. This indicates that L2 learning not only influences child L2 users’ cognitive processes, but also influences their current practice, that is, their on-line cognitive processing.

Table 3. T-test (two-tailed) values of response times between groups

<table>
<thead>
<tr>
<th></th>
<th>EX</th>
<th>EX-EX</th>
</tr>
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<tbody>
<tr>
<td>Non-EX</td>
<td>( t (56) = 3.027, p &lt; .003 )</td>
<td>( t (42) = 4.257, p &lt; .000 )</td>
</tr>
<tr>
<td>EX</td>
<td>( t (48) = 2.026, p &lt; .043 )</td>
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</tr>
</tbody>
</table>

The main findings of the present study can be summarized as follows. Firstly, Japanese child incipient L2 users largely categorized objects on the SynThem relation. This finding is in support of those found in the previous concept and word association studies such as Wakabayashi (1973), Kashu (1973), Yoneoka (1987), and Murahata and Murahata (2007). Secondly, as L2 exposure increased, they modified, though slightly, their categorical preferences and came to categorize objects based more on the ParaTax relation as adult English monolinguals do (Smiley & Brown, 1979).

Thirdly, there were clear differences in response times between groups of different amounts of L2 exposure. Existing research evidence has shown, as Cook (1997, pp. 281-283) summarized, that bilinguals are less effective than monolinguals in the speed of linguistic processing such as anaphora comprehension tasks, acceptability judgments, decoding tasks such as ‘Mark the third letter from the left’ and list recognition and lexical decision tasks. Contrary to these findings in linguistic processing tasks, in the present study the child L2 users with more L2 exposure responded faster than those with less L2 exposure in an object categorization, that is, non-linguistic, task. Though what was attributable to this ‘acceleration effect’ of cognitive processing in a non-linguistic task was not clear, this finding implies an additive aspect of bilingualism which maintains that knowing another language other than the L1 extends our cognitive capabilities in some way. In other words, learning “a second language increases the normal capacity of the individual and, so, confers a benefit rather than creates a problem” (Cook, 1997, p.289).

5. Conclusion

This study was an attempt to explore whether L2 learning influences cognitive processes and processing of child L2 users who are learning English in a very limited L2 exposure context. The findings depicted in detail above evidently showed it does. As the amount of L2 exposure increased, child L2 users not so dramatically but definitely shifted their categorical preferences toward those of adult English monolinguals and their processing speed also became faster. Accordingly, these findings certainly provide further evidence for a L2 users’ compound state
of mind with more than one cognitive apparatus, that is, multi-cognition.

What is the most striking finding was that even two-hour-a-week L2 exposure made a significant difference in children’s cognitive dispositions. If this very early influence of L2 learning on children’s cognition is to be recapitulated in future studies, this could possibly form a presumption for SLA research particularly from a bilingual cognition perspective. That is, the threshold of cognitive modification as a consequence of L2 learning can be manifested far earlier than has been expected.

There remain some important issues that we should discuss on the relationship between L2 learning and L2 users’ cognition. For example, why do L2 users come to respond faster in a non-linguistic task as their L2 exposure increases? Is it also true for on-line processing of other cognitive tasks? Secondly, how do an individual’s cognitive processes and processing change over time? All of the studies related to this kind of research to date have been conducted cross-sectionally. Conducting longitudinal studies is of particular importance to find out about real shifts or changes of cognition in L2 users.

References


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Manuscript received: December 15, 2010
Published: December 31, 2010