Interpreting state-change: Learning the meaning of verbs and verb compounds in Mandarin[1]

Jidong Chen

Max Planck institute for Psycholinguistics

1. Introduction

Verb meaning is generally assumed to be internally structured, representable as a set of semantic components combined in a certain configuration (Levin & Rappaport Hovav, 1995; Pinker, 1989; Talmy, 1985). Across languages, there is variation in how this information is "packaged" in verbs and verb-related constructions[2] (Talmy, 1985, 2000). To learn verbs, children have to determine which semantic elements play a role in their meanings, and to discover the patterns by which these components are typically combined in the language they are acquiring (Behrens, 1998; Bowerman, 1994; Wittek, 1999, 2002). That is, they must identify which meaning components are "conflated" in a verb's semantic representation, and which are expressed by other means, such as particles or prepositional phrases. Previous studies have revealed that children often misinterpret the meanings of verbs with complex semantics such as state-change verbs.

In a study of the acquisition of common cooking verbs, Gentner (1978) observed that English-speaking children between 5 and 7 years old tended to interpret *mix* as if it only specified a certain manner of motion, but not a particular end-state; in contrast, they were able to correctly associate three manner verbs *stir*, *beat*, and *shake* with the appropriate manner. Gentner concluded that English-speaking children have more difficulty acquiring meaning components relevant to changes of state than those relevant to the manner in which an action is performed. She claimed that English-speaking children tend to ignore the result meaning in state-change verbs. Similarly, Gropen and his colleagues (Gropen, Pinker, Hollander, & Goldberg, 1991) found that children roughly 4 to 6 years old treated the state-change verb *fill* as if it only specified an agent performing a particular action, pouring, which often leads to the end-state of being full. Such misinterpretations of verb meanings do not seem to come from children's failure to perceive and conceptualize the end-state of state-change events. For example, in languages like English that encode end-state with particles, children use particles to express state-change before age two (Bowerman, 1994; Bowerman & Choi, 2001; Tomasello, 1992). Further, Slobin (1985) observes that children first apply case markers such as accusative and ergative case only to the arguments of transitive verbs that encode instances of the "Manipulative Activity Scene", a situation in which an agent brings about a physical and perceptible *change of state* in a patient by means of direct manipulation. Slobin (1985) also states that children's first tense/aspect markers emphasize the contrast between process and result. In other words, learners are attracted by state-changes and affected objects. In her study of German-speaking children's understanding of state-change verbs, Wittek (1999; 2002) found that children did not, in fact, totally ignore the state-change meaning in state-change verbs, but they treated it as being only optional rather than entailed. For example, they tend to interpret verbs such as *plücken* 'pick' and *abplücken* 'pick off' to mean *do an action with the intention to cause something to come off.*

There seems, then, to be a paradox: children show early sensitivity to the end-state of state-change events but they have difficulty in correctly understanding the state-change meaning of state-change verbs. This mismatch between children's perception and their understanding of the linguistic encoding of state-change events suggests that they do not yet know what semantic information is encoded in

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[2] Following Goldberg (1995), a construction, which can be a morpheme, word, phrasal combination, syntactic pattern, and so on, is defined here as a form-meaning pair such that some aspect of the meaning is not strictly predictable from its component parts or from other previously established constructions.

state-change verbs and that they have not yet fully acquired language-specific ways of packaging information in verbs and verb-related constructions.

How should we interpret these findings in a broader cross-linguistic perspective? Is there a universal preference for interpreting the meanings of state-change verbs in a certain way? In Germanic languages like English and German, state-change meanings can be encoded in different ways: (1) by monomorphemic verbs like *pick* and *break*, which conflate both a cause and a state-change; (2) by combining a monomorphemic state-change verb with a particle which adds further information about the state-change encoded by the main verb (e.g., *pick off*, *break into pieces*); (3) by combining a verb that specifies only an action with a particle that specifies a resultant state caused by this action (e.g., *blow out (a candle))*. These varied patterns of event encoding may cause children learning Germanic languages to have difficulty in teasing apart where the state-change meaning is located -- in the main verb, in the result particle, or in both the verb and the particle?

If this is the case, perhaps children learning languages that encode state-change more consistently will have an easier time. Mandarin is such a language: it consistently encodes state-change with a single linguistic form -- resultative verb compounds (RVCs). For example, the Mandarin counterpart of the English state-change verb *pick* or the verb-particle construction *pick off* is the resultative verb compound *zhai-xia* 'do.picking.action-descend', which consists of two verbs, *zhai* 'do.picking.action' and *xia* 'descend'. Each verb of an RVC encodes one aspect of a causal event, the first verb (V_1) specifying the causal action and the second verb (V_2) the result. To correctly interpret an RVC, Mandarin-speaking children have to discover not only the meaning that results from the combination of the two verbs, but also where the state-change meaning is located in the verb compound, i.e., the division of labor between the component verbs. The present study explores how Mandarin-speaking children interpret state-change in RVCs. In particular, it addresses the following two questions:

1) What meanings do Mandarin-speaking children assign to RVCs?
2) How do Mandarin-speaking children interpret the meaning of the action verb (V_1) of an RVC?

Section 2 briefly discusses the semantics of Mandarin verbs and verb compounds and Section 3 presents an empirical study that explores Mandarin-speaking children's knowledge of the semantics of RVCs and their component verbs.

2. Semantics of Mandarin resultative verb compounds and their component verbs

In Mandarin, monomorphemic state-change verbs are rather rare, and state-change is typically encoded with RVCs that consists of two root verbs (or adjectives[3]): V_1V_2. Both the V_1 and the V_2 are drawn from open sets of verbs and they may be either transitive or intransitive. V_1 is usually an action verb indicating the cause, and V_2 is a stative verb, an adjective, or an action verb indicating a change of state or an action caused by V_1. The possible "results" indicated by V_2 are: (1) a physical state, like *kai* 'open' in *ti-**kai*** 'kick-open'; (2) a change of location, like *xia* 'descend' in *zhai-**xia*** 'pick-descend'; (3) a mental state, like *dong* 'understand' in *ting-**dong*** 'listen-understand'; and (4) a caused action, such as *xiao* 'laugh' in *dou-**xiao*** 'amuse-laugh' and *ku* 'cry' in *ma-**ku*** 'scold-cry'. Mandarin RVCs exhibit the features common to all Mandarin verb compounds: (1) there are no morphological markers to indicate the relationship between the component verbs; (2) the ordering of the component verbs is rigid and iconic, with the verb that encodes the resultant state or action always in the second position of the compound; and (3) there is a tight relationship between the component verbs – no lexical phrases or aspect markers are allowed to occur between them, and aspect markers always follow the last verb.

An RVC, by its composition, neatly subdivides a causal event into two sub-events – the cause (V_1) and the result (V_2). As Talmy (2000) puts it, the referential terrain covered by a typical English state-change verb such as *break* is thus conceptually divided into two portions in Mandarin: the final outcome, conclusively confirmed by the result verb, and an action that leads to the outcome, indicated by the action verb. The majority of Mandarin action verbs are of either the "moot fulfillment" type (the verb does not in itself make any assertion about a state-change) or the "implied fulfillment" type (a particular state-change is implied, but not entailed) (Talmy, 2000). The implicature of fulfillment in the action verb by itself can be falsified in Mandarin, as in (1).

[3] Mandarin adjectives can be regarded as verbs when they function as predicates in a sentence, as they can directly be the predicate or centers of the predicate without a copular verb, and they can be followed directly by aspectual markers (Chao, 1968: 663).

(1) *Ayi* ***zhai*** *le* *pingguo, keshi* *mei* ***zhai-xia.***
Aunty **do.picking.action** PFV apple but not **do.picking.action-descend**
'Aunty picked the apple, but didn't pick it off.'

So, unlike English, which does not allow the paradoxical *Aunty picked the apple but did not pick it off*, Mandarin offers the option of using only an action verb, which does not in itself assert any state-change, to encode the causing sub-event explicitly, while remaining moot as to the resulting sub-event and leaving the lexicalization of this event, if any, to an additional verb. Typologically, Mandarin and English are complementary in their lexicalization of state-change (Talmy, 2000). English monomorphemic verbs (e.g., *pick, break*) generally specify the fulfillment of the state-change, and they require additional forms to express implied fulfillment or moot fulfillment, for example, progressive aspect (*she was picking the apple*) or the conative construction (*She picked at the apple*).

Mandarin RVCs are accomplishment or achievement verbs which denote telic events (Tai, 1984), and they frequently occur with the perfective aspect marker *le*. When *le* is used with a verb that encodes a situation with a clear boundary (as with an RVC), it signals the completion of a situation. But when the verb encodes a situation with no clear boundary (e.g., as with an action verb), *le* simply signals the termination of the action. The interaction between *le* and the Aktionsart of the verb is illustrated in sentence (1): the use of the perfective aspect marker *le* with an RVC (e.g., *zhai-xia le* 'do.picking.action-descend' + perfective) indicates that the state-change has occurred; in this case, the apple has come off. But *le* with an independent atelic action verb (e.g., *zhai le* 'do.picking.action' + perfective) indicates only the termination of the action (e.g., the picking action has been performed, regardless of whether the apple has come off). In sum, *le* only signifies termination, not state-change. State-change is entailed only with verbs with certain Aktionzart (Chao, 1968; Li & Thompson, 1981).

3. Learning the semantics of Mandarin RVCs and their component verbs

The Mandarin-specific encoding of state-change events raises the question of how Mandarin-speaking children learn the meanings of RVCs and their component verbs, especially the action verb (V_1) of an RVC, which encodes only a sub-part of the meaning conveyed by English state-change verbs like *pick*. The following section presents an experimental study of this issue.

3.1 The experiment

Four groups of children (mean ages 2;6, 3;6, 4;6, and 6;1) and a group of adults participated in my experiment (N = 10 per group). I used a set of stimuli that was designed by Wittek (1999, 2002) in her study of German-speaking children's learning of state-change verbs. This set consisted of 16 video clips, each depicting an agent performing an action. Eight of these depict State-change events: *wake someone, extinguish candle, break plate, crack nut, kill deer, pick apple, fill cup, close door*. The *wake someone* event, for example, shows a woman setting off an alarm clock near a sleeping man's head, causing him to wake up. The other 8 clips (No-state-change events) show the same causal actions, but the state-change does not come about; for example, the woman sets off the alarm clock but the man does not wake up. Each participant watched 4 video clips of each type, but no participant watched both members of a pair, for example, *wake someone* and *do the waking action but the other does not wake up*. Following Wittek's procedure, the child was invited to play a game with a toy puppy, who was said to be silly and eager to learn the child's language. Each trial started with a still picture of the video clip. The experimenter first pointed out the objects in the picture, and the puppy would then predict what was going to happen before the actor performed the action in the clip. The prediction always included an RVC, which stated that the end-state associated with the action would be achieved. For example, for a *pick apple* clip, the puppy would predict "*Wo xiang ayi yao* ***zhai-xia*** *pingguo* 'I think the aunty will **do.picking.action-descend** the apple' (The aunty will pick the apple)". After the child watched the video clip, she was asked to judge whether the puppy had been correct about what would happen. Two follow-up questions were asked: one tapped the child's understanding of the RVC and the other her understanding of the first verb (V_1) alone. Table 1 shows the questions and expected answers for the State-change and No-state-change versions of "picking an apple".

Table 1. Sample Questions and expected responses to two types of video clips

Questions	Expected response to State-change clips	Expected response to No-state-change clips
Q1: Taps the meaning of the RVC *Ayi* ***zhai-xia*** *le pingguo ma?* Aunty **do.picking.action-descend** PFV apple question-particle 'Did aunty pick the apple?'	YES	NO
Q2: Taps the meaning of the V_1 *Ayi* ***zhai*** *le pingguo ma?* Aunty **do.picking.action** PFV apple question-particle 'Did aunty do a picking action on the apple?'	YES	YES

There were two warm-up items to familiarize the child with the experimental procedure, and four control items that allowed me to identify children with a general "yes" bias. Half the control items required a "yes" answer and half a "no" answer. For example, for a video clip that depicted a woman fixing a toy car, the child was expected to say "no" to the puppy who predicted incorrectly that the woman would wash the car. Only the children who gave correct responses to these control items were included in my analysis.

3.2 The results

Let us first look at the participants' interpretation of RVCs, i.e., their responses to the first question (Q1): e.g., "Did aunty pick the apple?". Figure 1 shows the percentage of YES responses to Q1. A YES response to a State-change clip means correct interpretation of the RVC, i.e., the child correctly interprets the RVC as entailing a state-change. A YES response to a No-state-change clip, however, means **incorrect** interpretation of the RVC, i.e., the child incorrectly thinks that the RVC applies to the scene even though the state-change does not come about. As Figure 1 shows, all the participant groups gave almost 100% YES responses to the use of RVCs for the State-change clips, while there were few YES responses in any group to the use of RVCs for the No-state-change clips, i.e., participants rejected RVCs for such events. Although the children's groups showed a certain acceptance of RVCs for the No-state-change clips (e.g., 20% YES responses from the youngest group of children), and there is a gradual drop in YES responses with increasing age, the difference between age groups is not significant.

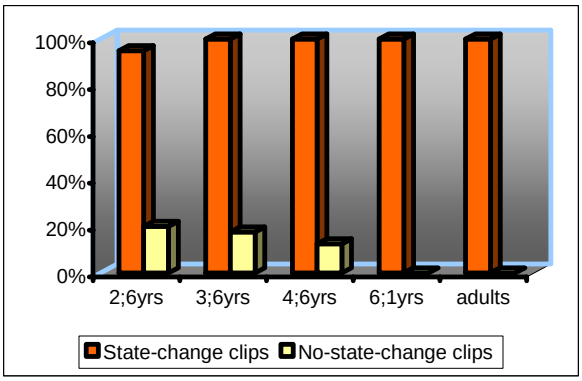

Figure 1. Percentage of YES responses to Q1: the meaning of an RVC

This result reveals that the children show very different response patterns to State-change events and No-state-change events. This suggests that they were sensitive to whether a certain result was achieved, and they knew from an early age that the state-change meaning is critical to an RVC: if no state-change occurs, even when an action has taken place that might be expected to lead to this state-change, it is not appropriate to use an RVC.

So it seems that Mandarin-speaking children know from a young age that RVCs encode a state-change meaning. But the learning task is not yet complete: they still need to correctly interpret the meaning of the component verbs, especially the first verb of the compound (V_1). Figure 2 presents the percentage of YES responses from all the participant groups to the second question (Q2), which tapped

the meaning of V_1, e.g., “Did aunty do the picking action on the apple?”.

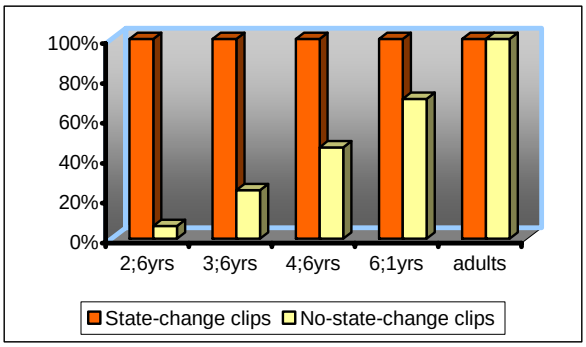

Figure 2. Percentage of YES responses to Q2: the meaning of V_1

A YES answer is expected on both the State-change and the No-state-change clips, since the V_1 of an RVC only encodes the action proper that leads to a certain result, regardless of whether the state-change is realized. The children are very similar to the adults in giving nearly 100% YES responses to the question about V_1 on the State-change clips. But they are very different in their responses on the No-state-change clips. Adults gave the expected 100% YES responses — the action of V_1 had taken place, even though the associated result had not come about — whereas the children were inclined to say NO. Apparently they thought, incorrectly, that the action of V_1 had not taken place, since the associated result did not follow. This suggests that children treat V_1, which does not encode a state-change, as entailing a state-change. All the child groups except the oldest (6;1) differed significantly from the adults in their responses on the No-state-change events ($p<.01$).

4. Discussion

Mandarin-speaking children differ from learners of English and German in their interpretation of state-change verbs. They have less difficulty in figuring out that a state-change meaning is crucial to certain predicates, since from at least as early as 2;6 they correctly reject the use of an RVC for an event if the state-change is not realized. The morphologically and semantically complex nature of RVCs does not seem to hinder them in coming to a correct interpretation of the state-change meaning. But Mandarin learners do have difficulty in learning the packaging of meaning in the simplex action verb (V_1) of an RVC: they incorrectly treat it as entailing a state-change meaning. This incorrect interpretation is rather persistent among children even as old as age six. Recall that German children often incorrectly treat the state-change meaning of state-change verbs as only optional, whereas it is in fact entailed (Wittek, 1999, 2002). Paradoxically, the Mandarin data point to the opposite learning problem: learners of Mandarin often incorrectly treat the V_1 of an RVC as if it *does* entail a state-change, even though it does not! This suggests that the problem for learners of German is not simply that they underestimate the importance of an entailed state-change meaning, since in this case we could expect learners of Mandarin to do the same, but that the different patterns of event lexicalization in the two languages present different challenges to the learner. My study so far does not allow me to come to a definitive conclusion about why Mandarin-speaking children treat a simplex verb (the V_1 of an RVC) as entailing a state-change, or why they persist for so long in making this error, but I would like to suggest the following lines of speculation:

1. Children’s errors may reflect how they hear adults use state-change verbs: adults may often use simplex action verbs for situations where a state-change has taken place. Some monomorphemic action verbs in Mandarin are implied fulfillment verbs, which point to a certain canonically expected result. For example, the verb *guan* ‘close’ implies ‘become closed’. But this implied result can be cancelled in situations where the closing act happens but the closure fails – e.g., *wo guan le men, keshi men mei guan-shang* ‘I closed the door, but the door did not close’. When adults use *guan* ‘close’ in situations where a closure actually takes place, it may mislead the child into associating the monomorphemic action verb with a state-change. Some evidence comes from a case study of an implied fulfillment verb *zhai* ‘do.picking.action’ in a spontaneous Mandarin speech corpus -- the Beijing Mandarin corpus of CHILDES (MacWhinney, 2000; Tardif, 1993). This verb was very often used as a simplex verb (33 out of 37 tokens) in adult speech in situations where

something (a hat, or a flower)[4] was taken down or meant to be taken down (as in requests or orders). The use of an RVC, *zhai-xia-lai* 'do.picking.action-descend-come', occurs only three times in such situations.

2. Mandarin-speaking children may treat the perfective aspect marker *le* as a cue that the simplex verb (the V_1 of an RVC) encodes a state-change. As discussed in Section 2, *le* does not in itself necessarily indicate the completion of an event or action, but only its termination. The meaning of completion comes from the Aktionsart of the verb with which it occurs. Slobin (1985) proposes that process and result define a basic semantic contrast in children's early acquisition of tense and aspect markers. Whenever a language has an acoustically salient past tense or perfective marker on the verb, he suggested, its first use by children is to comment on an immediately completed event that results in a visible change of state. Previous studies of Mandarin acquisition show that Mandarin-speaking children develop an early sensitivity to the association between telic verbs (e.g., RVCs) and *le* (Li, 1990; Li & Bowerman, 1998; Li & Shirai, 2000). Possibly children actually misinterpret *le* as a marker of state-change, i.e., they have not yet figured out that *le* signifies only termination, and that the state-change meaning, if any, comes from the association of *le* with an accomplishment or achievement verb such as an RVC.

3. The error of treating a simplex verb (the V_1 of an RVC) as if it entails state-change is very persistent. Perhaps this is because children are only rarely provided with the kind of evidence that they need to correct their hypothesis: applications of the verb by adult speakers to situations in which the associated state-change does *not* in fact come about. It may be much more common for adults to use these verbs for situations in which the state-change does come about.

5. Conclusion

To conclude, my study provides evidence for language-specific patterns in the learning of the semantics of verbs and verb compounds. Children acquiring different languages are faced with different lexicalization puzzles. This cross-linguistic variation leads to different learning patterns. It seems to be easy for Mandarin-speaking children to learn that RVCs entail a state-change meaning, but they have trouble determining exactly where the state-change meaning is encoded: in V_1, V_2, the whole RVC, or the perfective aspect marker *le*.

[4] Mandarin *zhai* covers a wider range of events than its English counterpart *pick*. It can be used to encode not only events involving separating a fruit or a flower from its stem, but also events of taking an object from its current location (usually down from a higher position), such as taking one's hat off one's head.

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