Learning Nouns for Objects and Verbs for Actions: The Roles of Social Interaction and Linguistic Structure in Chinese Lexical Acquisition

XIAO, Wen

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Thesis/ Assessment Committee

Professor Qian Wang (Chair)

Professor Him Cheung (Thesis Supervisor)

Professor Catherine A. McBride-Chang (Committee Member)

Professor Hintat Cheung (External Examiner)

Professor Kevin Kienhoa Chung (External Examiner)

Abstract

The present research examined Chinese toddlers' word learning, with a special focus on how they mapped novel words onto objects and actions in a single naming episode. Social interaction and linguistic cues were proposed to be effective in helping children successfully identify the referents of novel nouns and verbs. Using a preferential looking paradigm, 2- and 2.5-year-olds were tested on their acquisition and comprehension of novel words. In Study1, the results suggested that the toddlers were learning novel labels as verbs with reference to what was new to the speaker, mapping the novel labels to actions that were introduced as a new element in the discourse context. The results of Studies 2 and 3, showed that grammatical auxiliaries and the basic subject-verb-object (SVO) word order in Cantonese and Mandarin were useful to the learners in their search for the right meaning of the novel label. Study 4 ascribed a more powerful role of linguistic cues in helping toddlers identify the action as the referent for the novel word, compared with social information. Taken together, these four studies illuminate the contributions of different kinds of information to toddlers' early representation of novel verbs and nouns. The difficulties in verb learning compared with noun learning were also discussed. The conclusion was drawn that 24-month-old toddlers were able to map novel verbs, and further, to extend them to scenes that differed from the ones they had seen during familiarization. Similar to noun acquisition, social understanding can also bias toddlers' interpretation of novel words as verbs. In addition, the syntactic rules in the native language play a relative more important role in verb learning.

中文摘要

本研究考察中文幼兒的詞彙學習機制，特別側重於動詞和名詞的命名。社會能力和語法提示被認爲是有效地幫助孩子成功地識別名詞和動詞參照物。實驗使用優先注視法對 2 和 2.5 歲孩子進行測試。實驗一的結果表明，幼兒在學習動詞會參考命名者的意圖，根據語境中出現的新元素去確定新詞指向的是動作。實驗二和三表明幼兒能夠使用中文的語法和詞序去判斷新詞合適的意義。實驗四發現語法提示的作用大於社會語用信息。總括來説，這四個研究闡明了不同類型的信息對幼兒的早期詞彙獲得的幫助。討論集中在學習動詞的困難與及動詞名詞的學習機制的比較。得出的結論是 24 個月大的幼兒可以識別動詞指向的動作，並進一步擴大該動詞的適用範圍。同名詞類似，社會語用理解對幼兒掌握新詞是有用的綫索，而句法規則在母語發揮重要的作用相對動詞學習較爲重要。

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CONTENTS

CHAPTER ONE- Introduction

Children' dramatic success in word learning has captured special interest within the cognitive sciences because of its apparent difficulty at the mapping level. Previous research on lexical development of English has revealed an early learning preference for nouns over verbs (i.e., the noun bias) (Gentner, 1982). Children are strikingly good at object naming but find it more difficult to map verbs onto actions. Theoretical analysis suggests that these two grammatical categories differ in their underlying courses of acquisition. However, evidence from cross-linguistic studies suggests that the structural features of a language may affect how nouns and verbs are acquired in that language, over and above the general cognitive mechanisms underlying lexical learning (Imai, et al., 2008; Golinkoff & Hirsh-Pasek, 2008). The present paper aims to examine the roles of some these intriguing processes in Cantonese lexical learning.

Social and linguistic cues are proposed to be effective in helping children successfully identify the referents of novel nouns and verbs. Language is not acquired in a social vacuum. It is hypothesized that younger children are more likely to refer to social cues before syntax and grammar are available while older children rely more on the linguistic structure to learn nouns and verbs. The purpose of present research is to examine how Cantonese-speaking children become able to differentially recognize the referents for nouns and verbs in pragmatic contexts and with the aid of linguistic cues.

It is particularly interesting to investigate whether there are specific patterns in linguistic development in Mandarin- or Cantonese-learning children, because they are faced with a grammar that is generally regarded as too flexible on the surface to provide many useful cues for lexical learning (e.g., relatively free word order, lack of inflections, eclipse of noun phrases). The present set of studies thus sheds light on the roles of universal conceptual development in social understanding as well as language specific factors that facilitate young children's noun and verb learning.

The mapping problem in word learning

Explaining child language acquisition has always been a fascinating and controversial endeavor, since it is the most important cognitive achievement in infancy and childhood, which underlies almost every other communicative, social and psychological ability. The present studies focused on the earliest stages of language acquisition, which is perceived as the period when drastic changes in vocabulary are observed in the child. The years witness the emergence of language in children. Indeed, it was clear from the start that language learning taps the most fundamental cognitive resources in the child and that accounting for it involves probing the crucial relationship between language and cognition, universal principles and particular languages. More importantly, studying language learnability clearly provides evidence for controversial claims about current models of lexical learning, and most specifically, the nature and origins of syntactic knowledge. It is not controversial anymore that some part of humans' ability to acquire language is innate. But what exactly is innate is an open question yet to be answered.

To introduce the classic problem in word learning, Quine (1960) described a scenario in which a linguist travels to a foreign land to learn the language of a newly discovered population. There is an induction problem when he sees a rabbit running by and hears the native saying, "Gavagai"; he finds it hard to understand what the word refers to in such an ambiguous situation since there are indefinitely many ways to interpret the word. It could refer to the rabbit or the action of the rabbit. The case becomes even more complicated for children at the beginning stage of language acquisition. A big challenge for them is to identify the appropriate referents that the speaker intends to label and associate new words with nameless objects, actions, or attributes.

Major approaches to the mapping problem

A theory of word learning therefore must determine a procedure by which children can easily eliminate alternatives and map the words with the referents. In the past few years, there has been an explosion in research about early word acquisition. A number of diverse theories have been provided to explain how children solve the dilemma of word learning. One approach emphasizes word-learning constraints or principles as a powerful tool to identify the referents (Golinkoff, Mervis, & Hirsh-Pasek, 1994; Woodward, 2000; Markman, 1989). With some innate constraints or principles biasing them to entertain certain hypotheses about some word references over others, young children can easily identify the referents of novel words and successfully acquire the vocabulary. Such constraints are available to babies by the time of the naming explosion. For example, the principle of mutual exclusivity assumes that an object can have only one name. If children apply this principle to word learning, they won't label an already named object with a novel name.

In contrast with the previous domain-specific constraints in word learning, a second approach believes that the general cognitive development of associative learning is sufficient for early lexical acquisition (Smith, Jones, & Landau, 1996; Smith, 2000). Word learning can be simply accounted for through "dumb attentional mechanisms" like perceptual saliency, association, and frequency. Acquiring novel words is learning the links between noticeable things and concurrent sound sequences. Thus children do not need constraints or principles to forge word-to-world mappings.

A third approach emphasizes the social pragmatic context in which word learning occurs (Akhtar & Tomasell, 1996; Bruner, 1983; Bloom, 2002; Tomasello, 1992; 1995). The theoretical assumption under the social-pragmatic account is that children infer the meanings of words by relying on an understanding of people's minds in relation to the pragmatic context. There is considerable evidence on young children's

ability to deploy social understanding to aid language learning (e.g., Akhtar, Carpenter & Tomasello, 1996; Baldwin, 1993; Baldwin, Markman, Bill, Desjardin, Irwin & Tidball, 1996; Baldwin & Moses, 2001; Tomasello & Barton, 1994). For example, 18- to 24-month-olds attend to speakers' gaze direction (Baldwin, 1993), affective expression (Tomasello, Strosberg, and Akhtar, 1996) and other behaviors (Tomasello & Barton, 1994) as cues to the speakers' intents to name objects. In particular, children' gaze following is found to predict later growth in vocabulary. It is reasoned that children who take the advantage of understanding adult gaze as a referential act can learn new words in everyday interactions with adults more easily (Meltzoff & Brooks, 2009). It is as though the object that is named acquires a special valence through gaze so that children can identify it from the surroundings and label it. However, the acquisition of new words is more than sheer associative learning as claimed in the second mentioned approach (Diesendruck, Markson, Akhtar, & Reudor, 2004). A child has to infer that the word uttered corresponds to the things or events on which the speaker is focused. It is important for the listener to understand the intention of the speaker in order to determine the referents of words.

As mentioned above, there is a range of cues available in the real word as cues to learn new words, however not all cues are equally utilized in the service of word learning. The emergentist coalition model (ECM) suggests a developmental process of word learning, from one based in perceptual salience and association to one embedded in social understanding (Hirsh-Pasek, Golinkoff, Hennon, & McGuire, 2004). According to this model, children can learn novel words with multiple cues, such as attentional, social, and linguistic cues. But for the novice word learner, perceptual salience is more heavily weighted than social cues, compared with the expert word learner. Children are first attracted by what is most salient to them and only later note what is important to the speaker. Before they break through the

language barrier, children are guided by associationist principles. As they mature into experienced word learners, social-pragmatic strategies become more powerful in guiding their word learning.

To assess these hypothesized development, children at three ages were tested; 12- to 13-month-olds just at the beginning stage of word learning; 19- to 20-month-olds experiencing a vocabulary spurt; and 24- to 25-month-olds with sizeable production vocabularies (Hollich, et al., 2000). They used the preferential looking method to measure children's comprehension of novel words when multiple cues were made available to them but were sometimes placed in conflict. In the coincident condition, a speaker labeled an interesting toy that coincided with the children's preference. However in the conflict condition, the experimenter looked at and labeled a boring toy which did not coincide with the children's preference. The results showed that 12-month-olds could not use the social cue of eye gaze when it was in conflict with perceptual salience. The younger children ignored the social cues and mismapped novel labels onto the objects they themselves were interested in (not the one the speaker intended to name). Not until 18 months could the babies downplay perceptual salience and recruit the speaker's referential intent to learn an object name regardless of its perceptual attraction. These data show a clear pattern of changes over time such that infants become increasingly less dependent on perceptual cues and more dependent on social cues to determine reference.

A comparison of noun and verb learning processes-Data from expressive vocabulary and experimental tasks

Every human language is comprised of different grammatical categories, e.g., nouns, adjectives, verbs, etc. These different kinds of words can possibly be describing the same scene but highlighting its different aspects. To be successful in

word learning, learners have to identify a novel word's grammatical form, discover its appropriate referent, and establish a word-to-world mapping relationship between them. By the end of the first year, infants are well on their way to solve these problems. Previous research have demonstrated that infants in their first year become increasingly sensitive to perceptual cues and distributional regularities that mark word and phrase boundaries in their native languages (Fernald, 1992; Jusczyk & Aslin, 1995; Marcus, Vijayan, Rao, & Vishton, 1999; Saffran, Aslin, & Newport, 1996). By 9-12 months, infants can successfully parse individual words from the continuous speech stream and spontaneously begin to build a lexicon consisting primarily of nouns, adjectives, and verbs (Morgan & Demuth, 1996; Shi & Werker, 2003; Shi, Werker & Morgan, 1999; Werker, Lloyd, Pegg, & Polka, 1996).

Most studies of English vocabulary checklist and corpus data have found that nouns instead of verbs dominate early utterances (Goldfield & Reznick, 1990; Halliday, 1975; Markman, 1989; McShane, 1980; Nelson, 1973). In Gentner (1982), the phenomenon whereby nouns are acquired earlier than verbs was referred as a "noun bias" and the reason accounted for this "noun bias" was that children have a conceptual predisposition early on to treat words as mapping onto objects. Empirical evidence favoring the acquisition of nouns over verbs mainly derives from one of the most comprehensive quantitative assessments of children's word learning, the McArthur Communicative Development Inventories (MCDI; Fenson et al., 1994). It reveals that children' early lexicons tend to be dominated by nouns, while verbs do not appear in appreciable number in children' productive lexicons until several months later, around 24 months old (Tardif, Gelman, & Xu, 1999).

More recently, researchers have been debating whether children exhibit a universal "noun bias" when learning their first languages. Evidence from studies on Mandarin-speaking children (Tardif, Shatz & Naigles, 1997; Tardif, Gelman & Xu,

1999) and young children in Korea (Choi & Gopnik, 1995; Kim, McGregor & Thompson, 2000) has cast doubt on the universality of the noun bias phenomenon. From an examination of natural speech corpus, Tardif (1996) found that 90% of 22-month-old Mandarin-speakers produced more verbs or action words than nouns or object labels. Tardif and her colleagues (1999) later compared the proportion of nouns and verbs in the vocabulary of English and Mandarin-speaking infants (mean age 20 months) and their mothers. Compared with their English-speaking counterparts, Mandarin-speaking children used relatively fewer nouns and more verbs. A significant predominance of verb usage was also found in the expressive utterances of Cantonese-speaking children (Tse, Chan, & Li, 2005). This observational evidence on the one hand implies considerable success in verb learning in Mandarin-speaking children. On the other hand, whether or not a "noun bias" exists in the early stages of vocabulary acquisition may depend on the methods by which their vocabularies are sampled and the contexts in which their speech is uttered.

When noun and verb learning were examined and compared in laboratory-based tasks, younger children were found at a disadvantage in acquiring the meanings of verbs compared to nouns. In a human simulation paradigm, Piccin and Waxman (2007) tested children's conceptual capacity of nouns and verbs by asking them to identify the blurred words in adults' simulated conversations. Seven-year-old English-speaking children performed similarly as the adults with a higher successful rate of identifying nouns than that of verbs. In Childers and Tomasello (2002)'s study, 2.5-year-olds were taught novel nouns, novel verbs or novel actions and their comprehension and production were measured after training. The results documented that children produced more new nouns than verbs and the relative ease with which children learn nouns versus verbs was discussed. Woodward (1993) presented 18- and 24-year-olds with two simultaneous video displays, one showing a static object and

the other a substance in motion. When they heard a new label, 18-month-old children focused on the object rather than the substance in motion, despite a baseline preference for the motion display. 24-month-olds did not show this difference. In another study of word-object bias, children were taught a novel label for moving objects with habituation paradigm and then shown test events in which either the motion or the object was switched in the presence of the original label (Katerelos, Poulin-Dubois, & Oshima-Takane, 2004). Since no syntactic cues were available to specify the grammatical form of the label, both English- and Japanese- speaking children preferably matched the novel label to the object instead of the motion.

Despite early appearance of verbs in Mandarin-speaking children's lexicon, this empirical fact does not guarantee successful verb learning, as witnessed by 3-year-old Chinese-speakers' difficulty mapping verbs to causal events in Imai et al (2008). During the training session, the children heard either a novel noun or a novel verb accompanied by a video of an action event involving a novel action and a novel object. In the test, two variants of the standard event were presented simultaneously to the children, one being the same action with a different object and the other being a different action with the same object as the standard event. The 3-year-olds successfully mapped a novel noun to an object, generalizing it to the same object used in a different action. In contrast, they failed to map the novel verb to the same action when the object was replaced. These results for Mandarin-speaking children converge with that for English-speaking children, both suggesting that children more readily map and extend novel nouns than novel verbs. Apparently, early appearance of verbs in children's lexicon does not mean that children appreciate the full meanings of the verbs as adults do.

Why are verbs more difficult to learn than nouns?

It has been shown that learning of verbs often lags behind that of nouns in both studies of natural vocabulary acquisition and laboratory research on verb comprehension (e.g., Fisher, Hall, Rakowitz, & Gleitman, 1994; Gentner, 1982; Hollich et al., 2000; Choi & Bowerman, 1991; Choi & Gopnik, 1995; Tardif, Shatz, & Naigles, 1997). Generally speaking, what verbs describe is inherently relational and less perceptually salient, compared to the referents of nouns. Hence it is more difficult to acquire verbs than nouns. In the following, specific learning problems for verbs were discussed and the Emergentist Coalition Model (ECM) was highlighted to unpack the complexity of verb mapping (Hollich, et al., 2000).

Conceptual representation of actions in events

One reason why verb learning is challenging might be that children have difficulty in representing the relational components of event categories. The perceptual and conceptual factor is that objects are easier than actions to parse from the environment (Gentner, 1982; Gentner & Boroditsky, 2001; Maguire et al., 2006). In contrast with that objects are temporally stable, actions are ephemeral. It's not easy to find the boundaries because the beginning and ending of an action is not clearly marked. Imai et al (2005) found that children encode and remember objects more easily than actions. In the absence of language, 3-year-olds had difficulty encoding and remembering the novel actions when the objects involved were changed but have no problem in recognizing the novel objects even the actions performed on it were different.

Yet, evidence from other studies suggests the conceptual underpinnings for many verb concepts develop early. Children are sensitive to fundamental components of events, e.g., 'containment and support', 'path and manner' and 'source and goal' (Lakusta, et al, 2008). They are able to discriminate these components as independent

units and categorize similar event types together. Based on this evidence, it is unlikely that child's relatively delayed acquisition of verbs stems from an inability to represent the kinds of concepts that underlie verb meaning. The difficulty might be rooted in word-to-world mapping.

If the strategy for word mapping is to preferentially attend to referents that are perceptually salient, young children might map novel words to salient objects or events in the context. For example, 10-month-olds disregards the speaker's intention to name a boring object and map the novel label onto an object they find interesting. As for verb learning, 21-month-olds learned the name of an interesting action 'with a result' (i.e., pressing some part of toy produced a tone) but failed to do so when the result of the same action was disabled (the boring action, i.e., pressing the toy resulted in silence) (Brandone, et el., 2007). In another study, the names of the actions performed by the learners were easier to acquire than those acted out by others (Smiley & Huttenlocher, 1995). If the action performed by an unknown agent or by multiple agents, the children's attention focuses on the agents rather than on the relation and interferes with verb learning. Magurie et al. (2008) reported that exposure to a single actor rather than multiple actors resulted in better verb learning in 2.5-year-olds.

Because nouns are more imageable than verbs (Ma et al., 2009), the conceptual factor, imageability, which indicates the ease with which a mental image can be generated, was used to account for the effect of perceptual salience (McDonough, et al., 2011). A word's imageability ratting contributes to the variance of the word's age of acquisition above and beyond the form class (nouns and verbs). Word with higher imageability ratings tend to be acquired earlier than words with lower imageability ratings simply because high imageable words are easily perceived as separate and distinct. Somehow imageability relates to the saliency and consistency of contexts in

which the word to objects or word to actions pairing occurs. This is consistent with the argument that more salient actions are easier to be encoded and represented as the referents for the verbs.

Regarding the relative ease to map novel nouns and verbs in a concurrent context, verbs are harder to acquire because the scenarios usually involve the actors and the objects which are often more salient than the actions themselves. Moreover, the events that verbs name are categorized differently across languages (e.g., Bowerman & Choi, 2003; Levinson, 1996; Slobin, 1996). It seems that verb semantics varies more across languages than does noun semantics, thus leading to a difference in word-to-world mapping transparency. The mapping between word and referent is more transparent for concrete nouns than it is for verbs. It appears that perceptual information is not enough to account for verb learning. To acquire the meanings of verbs, children need to recruit social and grammatical information.

Social information in verb learning

The important significance of human language is that it is social and communicative. Humans are inherently a social species. In seeking to establish a word's meaning, a rich array of social cues should be considered, including the eye-gaze, trustworthiness, and intentionality of the speaker. It appears that 24-month-olds or younger children are quite capable of reasoning about people's perceptions, desires, and intentions (Carpenter, Akhtar, & Tomasello, 1998; Gergely, Nadasdy, & Csibra, 1995; Leslie & Keeble, 1987; Meltzoff, 1995; Woodward, 1998). It is believed that the vocabulary spurt at the age of 18 months reflects qualitative changes regarding the nature of the way words are acquired. The spurt is proposed to mark the beginning of the referential use of language. And at around the same time lots of verbs begin to appear in children's early vocabulary (Bloom, 2002).

As argued by Tomasello and his colleagures (2000, 2003), language acquisition

is embedded in and can not be separated from social interaction. In discussion of verb learning, children have to apply their understanding of social information, (a) in discerning the speaker's attentional focus and communicative intent, and (b) in inferring the intent of the actor.

Research findings have documented that children are capable of taking into account speaker's referential intent to interpret new labels for objects (e.g., Akhtar, Carpenter & Tomasello, 1996; Baldwin, 1993; Baldwin, Markman, Bill, Desjardin, Irwin & Tidball, 1996; Baldwin & Moses, 2001; Tomasello & Barton, 1994). There is evidence showing that toddlers are sensitive to whether an event was intentional in deciding verb meaning. For example, Akhtar and Tomasello (1996) demonstrated that by 24 months of age, children were able to infer the intent of a speaker to label a novel action, even though they have never seen that action performed in the presence of that label. The experimenter told the children that they were going to "meek" (a novel label) with Big Bird. After searching, the experimenter informed the child that she could not find Big Bird. The target action was then performed with other objects but never labeled. During the test, children were asked to "meek" with a new character, Cookie Monster. Two-year-old children were able to produce the action with the novel object at the same rate as the children who had heard the label while the action was performed. These results demonstrate children's ability to use their understanding of a speaker's communicated intent to resolve the problem of referential ambiguity and interpret the meaning of a novel verb.

Research also shows that children develop some implicit form of folk psychology of intentions-in-actions during the first two years of life. In order to refine their understanding of verb meaning, children must also attend to the intent of the actor performing a labeled action. For example, Poulin-Dubois and Forbes (2002) found that 27- month-olds, but not 21-month-olds, could use social cues when

distinguishing between novel actions that looked quite similar except for barely detectable social information. Specifically, 27-month-olds attended to the subtle cue of eye gaze when determining whether a verb meant something like topple or knock over. Children seem to understand that actions may be perceptually similar, but have distinct labels because of the intentions of the actor (see also Behrend & Scofield, 2006). These results hint at a sophisticated ability on the part of the verb learner to mind the social context and determine the meaning of a novel verb.

However compared with noun learning, social cues are less accessible to determine which components of the event is the focus of the speaker. The extralinguistic context is important however insufficient for interpreting verb meaning. To resolve the ambiguity, children need to rely more on cues other than social pragmatics.

The aid of linguistic structures in verb learning

Another explanation for a noun advantage appeals to the linguistic requirements underlying word learning—nouns predominate because their acquisition is well-supported by observation, while verbs often depend on additional linguistic information which early word learners are not yet able to utilize. It has been argued that linguistic structures play the crucial role in the case of acquiring the meanings of verbs. As opposed to nouns that label object categories, the referents of verbs are too abstract to be efficiently induced from extralinguisitc evidence alone (Gleitman & Gleitman, 1995; Snedeker & Gleitman, 2000).

According to the syntactic bootstrapping theory, the learner can apply grammatical constraints on the relation between verb meaning and verb syntax to narrow down the hypotheses about the verb's meaning (Landau & Gleitman, 1985). For example, the meaning of a verb is usually related to the number and arrangement of arguments in the sentence. Causative verbs (i.e., bring) typically appear in

transitive frames which include both a subject and a direct object, and non-causative verbs (e.g., come) typically appear in intransitive frames in which no direct object is indicated. When the familiar intransitive verbs were followed with an extra post-verbal noun phrase (NP), the toddlers extended causative meanings to these verbs, while familiar transitive verbs with absence of a post-verbal NP were extended as non-causative.

It is well documented that toddlers are able to make such inferences about verb meaning on the basis of the sentence structures that the words appear in (Fisher, 1996; Fisher, Hall, Rakowitz & Gleiman, 1994; Landau & Stecker, 1990; Naigles, 1990, 1996; Naigles, Gleitman & Gleitman, 1993; Naigles & Kako, 1993). In Naigles (1990)'s study, 25-month-olds were familiarized to a complex event (e.g., a duck bends a bunny over, or both duck and bunny make arm circles). At issue was whether the learners used the syntactic context in which a novel verb was presented to decide which components of an event was key to its meaning. The children who had heard the transitive verb looked longer at the causal scene while the children who had heard the intransitive verb looked longer at the noncausal scene. This outcome reveals that children possess some rudimentary knowledge about how the number of arguments in a sentence affects its interpretation. Other evidence suggests that children would assign a new meaning to a familiar verb which was placed in a novel frame (Naigles, Fowler, & Helm, 1992; Naigles, Gleitman, & Gleitman, 1993).

Data from analyses of maternal speech to Mandarin-learning toddlers have revealed that transitive verbs appeared with postverbal NPs only 39% of the time while intransitive verbs appeared with such NPs as much as 13% of the time. Granting that Chinese provide no morphological cues to distinct transitive and intransitive verbs, Lee and Naigles (2008) showed that Chinese learners could still use the number of NP arguments in verb interpretation.

Summary of past research on verb learning

Given that perceptual, social, and linguistic cues are available in young children, it becomes an issue that how children package the information to determine which aspect of an ongoing event is being referred to. The ECM (the Emergentist Coalition Model, Hollich, Hirsh-Pasek, Golinkoff, 2000) predicts that children first map words onto concepts that are perceptually salient, and later they develop to recruit social and linguistic cues to assist word learning. This theory not only is applied to noun but also verb learning. It's built on a continuum that describes the conceptualities of the words, from concrete to abstract. As one moves towards the more abstract end of the continuum, mapping from word to world becomes too ambiguous to solve without recruiting social and linguistic cues. Especially, the above analysis implies that understanding linguistic structure is more important for verb than noun learning, which may account for the reason that verbs are learnt slower than nouns.

Other theorists argue that early word learning is more accurately depicted as a process of children learning the rules of word use rather than agreement of referential intent (e.g., Montgomery, 1997, 2002; Wittgenstein, 1985). According to this argument, young children are not developing mental representations of words referring to objects, events, or internal mental states early on. Rather, they are learning to mimic word use in context. Later on, they gradually develop the symbolic understanding of word reference as well as the mental representation.

How language structure influences word learning: Evidence from Mandarin-speaking children

Verbs predominate over nouns overall, both in types and tokens, in the maternal input and in the expressive vocabulary of Chinese speaking children (e.g., Tardif, Gelman, & Xu, 1999; Tse, Chan, & Li, 2005). It is established that verbs rather than

nouns dominate the expressive vocabulary of Chinese toddlers. This linguistic property might lead us to expect that verb learning should precede noun learning.

However, experimental studies of teaching new words have suggested otherwise. Some astonishing failures in Chinese children learning novel labels for actions have been noted. A study comparing noun and verb learning across children speaking Japanese, English, and Chinese serves to illustrate this point (Imai et al., 2008). The results indicated that all the children mapped and extended novel nouns more readily than novel verbs. Both the 3- and 5-year-olds were able to map the novel noun to the novel object but only the 5-year-olds were able to appropriately generalize the novel verb on the basis of the sameness of the action. The performance of Chinese children in this learning experiment seems to contradict what previous production and checklist data have suggested. Even though verbs appear early in their vocabulary, they found it hard to map and extend a novel label to the actions in a novel learning context. The discrepancy is explained by the different levels of verb meaning representation. The appearance of verbs in the lexicon does not mean children appreciate the full meanings of the verbs in an adult-like way.

It is possible that the nature of language would have an impact on verb learning. The motivations for studying verb learning in Chinese are manifold. First, Chinese verbs lack inflections, and so do Chinese nouns, which makes it difficult to tell whether an isolated item is a noun or verb. As a result, Chinese children may rely much on extralinguistic cues to determine the grammatical category of the item. In Imai et al. (2008), English-speaking 5-year-olds successfully mapped and extended the verb to the same action when the sentence structures matched with the grammatical class. However, Chinese 5-year-old children had a strong tendency to fast-map a novel word to a novel object, regardless of whether the word was presented as a noun or a verb, or as a bare word. They could not map a novel verb to

the action unless the object was deemphasized, showing that they were extremely sensitive to subtle contextual cues.

Furthermore, there are a large number of ambiguous words that can be treated as both nouns and verbs in Chinese. Linguists call them "words of dual membership", which are related in meaning and identical in pronunciation and orthography. An fMRI study found that Chinese nouns and verbs activate a wide range of overlapping brain areas, which seemed to contrast with the findings from English and other Indo-European languages (Lin, Jin, & Tan, 2004). The non-distinct brain responses to these two word types might arise as a function of native speakers' experience with the specific linguistic features of the Chinese grammar. Chinese has a large number of words that can be used as both nouns and verbs. The feature of the input may affect how Chinese children identify a verb in the pragmatic context. Due to less accessible linguistic cues, more sophisticated linguistic and extralinguistic knowledge may be required to understand the meaning of a novel word.

Moreover, Chinese verb arguments are frequently dropped (e.g., the nouns surrounding the verbs are not expressed), which means it is possible that a verb is the only word in the sentence as the arguments can be inferred from the context. In English, the ellipsis of subject and the object of the sentence virtually never occur. For example, it is acceptable in Chinese to say "diao4 le1" "(you) dropped (it)" without mentioning either who is to drop the thing or what is to be dropped. As a result, a novel word can be taken as a verb only when it is embedded in the argument structure of the prior discourse. In Imai et al. (2008), Chinese-speaking children interpreted a novel word presented in the absence of syntactic support as an object-name instead of the action.

Theoretical importance of studying Chinese-speaking children

It seems Mandarin-Chinese presents a "worst case scenario" for the use of syntactic bootstrapping to distinguish the verbs from the nouns in novel word learning due to the special linguistic property that Mandarin lacks morphological distinction between nouns and verbs. On the other hand, Chinese is said to be verb friendly language because of its lexical distributional properties (Choi & Gopnik, 1995; Ogura, 2001; Tardif, 1996). With argument dropping, verbs should be relatively more frequent in Chinese than in English. Additionally, the morphological simplicity of Chinese verbs might give an advantage to Chinese verb learners, as children do not need to learn various inflectional forms of the same verbs (Tardif, 1996). The disagreement between the two arguments was purely based on the description of linguistic properties however lack of empirical support. The purpose of present research was to document young children's comparative easiness in noun and verb learning through studies of teaching new words.

The research was motivated by a developmental theory of word learning (the Emergentist Coalition Model, ECM, Hollich, Hirsh-Pasek, Golinkoff, 2000). A comprehensive approach to word learning that accounts for why some words are learned before others was proposed. The theory characterizes lexical acquisition as the emergent product of multiple factors, including cognitive constraints, social-pragmatic factors, and global attentional mechanisms. The assumptions underlying is that children selectively use one of the multiple inputs available for word learning and these inputs are differentially weighted over development. That is, the acquisition of lexical items, regardless of word class, is first driven by children's reliance on perceptual information and later through attention to social and linguistic information. In the same context, the focal objects are presumably more perceptual salient than the actions (Genter, 2006). Not until the end of 2 year old do toddlers use

social and linguistic cues to decipher word meaning and overcome the perceptual bias. Thus my research would focus on the age of 2 and 2.5 year old when subtle social cues and linguistic input start to affect the process of word learning.

According to the ECM theory then, the words children initially learn will be perceptually tied and contextually bound. This will be the case irrespective of syntactic word class. Being able to interpret speaker and actor intent is essential to arriving at the correct noun and verb meanings. The present research first established Chinese children's ability to discern the meaning of novel word with reference to the speaker's intents.

Syntactic frames serve to constrain the possible interpretations of a novel verb, because frames have semantic implications for the verbs that appear in them (Fisher, 2002; Fisher, Hall, Rakowitz, & Gleitman, 1994; Gleitman & Gillette, 1995; Naigles, 1990; 1996). Unlike the case with English, it is harder for Chinese speakers to determine the grammatical form class of a word without inflectional morphological markings. Linguistic cues such as aspect-marking auxiliaries that accompany verbs (e.g., "zai" for progressive, "le" for perfective) are salient cues to indicate verbhood. But because they are not inherent to the word nor are they obligatory, this cue may not be strong enough to help young children identify the verbhood. In the present study, the proposal that aspect-marking auxiliaries might lead children to identify a novel word as a verb is investigated.

Another plausible way to disentangle verbs in ambiguous circumstances is to note the order of the constituents in a sentence. Whether the patient is mentioned or the structural positions of nouns would affect how children interpret the meaning of the novel word. Based on probability, word order provides a cue for determining the form class of each word in a sentence. The canonical word order in Chinese is subject-verb-object (SVO). However, variants such as OSV, SOV, and VOS are also

common. Thus to identify a word's grammatical class, Chinese learners may rely on the typical word order at the beginning stage of word learning. Not until later can they combine semantic and grammatical cues, both at the global (such as argument structure) and local (such as auxiliary verb) levels (Li et al., 1993). Present research was motivated to examine whether young children were able to use word order to distinguish the semantic meaning of noun and verb class.

According to usage-based accounts (e.g., Tomasello, 2000) one important factor for lexical learning is the distributional information in language input. This claim argues that human language learners possess a powerful statistical learning capacity and they are highly sensitive to distributional features of the input. A distributional analysis is to categorize words based on their co-occurrence patterns with surrounding words and this information can be successfully used as a powerful cue to obtain a considerable amount of knowledge on grammatical category membership (Mintz, Newport, & Bever, 2002). Thus there are reasons to believe that early young children's word learning is influenced by the characteristics of their linguistic input and they are capable of using such rules to guide their interpretation of novel words.

As Imai and colleagues point out, many of the methods used in assessing children's existing vocabularies have some difficulties in setting up objective criteria for classifying a given produced word into its appropriate form. The present research would provide empirical evidence about how children acquire meanings of novel words in simulated learning context. Additionally, studies of teaching new words in Chinese-speaking children are scant and the results were inconsistent. The present research would fill in the gaps of word learning literature by providing a comprehensive picture of how Chinese young children use different cues to discern the meaning of novel words.

The research on early oral language would shed light on later reading

development. At the age of 2- or 3-year-old, children who later developed reading disabilities showed deficits in syntactic complexity, receptive vocabulary and object-naming abilities (Scarborough, 1990; Liu, et al., 2010). If the present research documented the major achievement in novel noun and verb learning at the certain age, it could be used as an indicator of early language ability that might contribute to later reading adequacy.

The preferential looking paradigm

The preferential looking paradigm has been widely used to study the processes by which young children learn novel words (in Golinkoff & Hirsh-Pasek, 2008; Imai, et al., 2008). In this paradigm, children see two simultaneous dynamic events with an auditory linguistic stimulus that matches only one of them, and the children's looking time dedicated to each event is measured. The basic logic of this paradigm is that children are supposed to look (or point when older than 30 month) at the matching scene more than the non-matching scene if they have correct understanding of the linguistic stimulus. Usually the attention during test trials can be compared to attention during salience trials with 'neutral' language to make sure the effect is not due to the inherent perceptual characteristics of either of the events.

Previous studies using the pointing response have indicated that 3- and sometimes even 5-year-olds seem to have difficulty extending a novel verb to other actions of the same kind if the objects associated with the action have changed (Waxman, et al., 2009; Naigles, 1990). In other words, the status of the focal object is rather critical in children's ability to generalize a verb. In the following experiments, I address some research questions focusing on 24- to 30-month-old toddlers' generalization of novel verbs and nouns. In order to make the task less difficult for younger children, I try to include the same action-object pairing in the test scenes so

that they are more likely to succeed in novel verb generalization.

Research questions

The above review of the verb and noun learning literature offers a new perspective on the early developmental trajectories regarding word learning for Mandarin-and Cantonese-speaking children. Children and young children apparently master the principles to generalize a novel noun based on the object category. However, mastering principles governing the generalization of verbs seems to be difficult. Even though there is a higher proportion of verb in Chinese-speaking children's vocabularies, the linguistic properties actually make it difficult to distinguish a verb from a noun. The issue of novel noun and verb learning becomes more complicated in Mandarin- and Cantonese-speaking children.

In the current research, I address these questions concerning Chinese young children's acquisition and generalization of novel verbs and nouns. I focused on the critical change period from 2 to 2.5 years and examined the learning processes in the mapping of nouns and verbs. This age range was chosen because acquiring a novel verb on the basis of a brief exposure would be possible. Two-syllable nonsense words were constructed and used as novel labels in the study because bisyllabic words are most frequent in Chinese and are neutral with respect to whether they are nouns or verbs.

I argue that children have different strategies to identify the referent for a novel word over time, which would shed light on the discussion surrounding the relative importance of general cognitive versus language-specific factors for word learning. I pursue the following hypotheses in four subsequent studies.

1. When given a bare novel word, can young children recruit some social cues to decide whether it refers to an object or action? I hypothesize that

when no linguistic information is available young children are able to interpret an isolated novel item as either a verb or a noun using their understanding of the pragmatic context.

2. Are linguistic cues such as aspect-marking auxiliaries or quantifies strong enough for Chinese young children to decide on the grammatical class of a novel word? I hypothesize that young children have some rudimentary understanding about this language-unique factor in verb learning.
3. Can Chinese children take word order as a cue to determine the form class of each word in the sentence? Based on the syntactic bootstrapping hypothesis, Chinese word learners are able to coordinate semantic and grammatical cues in order to derive the meaning of the novel word.
4. When linguistic cues are pit against extralinguisitic cues, how do 2-year-old Chinese children solve their problems in word learning? It is hypothesized that linguistic cues will override social cues at this relatively advanced age.

CHAPTER TWO – The Studies

Study 1. Two-year-olds use social cues to differentiate references to objects and actions

Previous findings indicate that young children are capable of using social cues to determine the speaker's semantic intentions. However, the limitation of these studies is that they only examine children's response within the categories of either object or action. That is, for object-naming tasks, children inferred the adults' intention to figure out which one of the available objects that was intended. For action-label studies, children knew that the adult was referring to an action and their job was to

figure out which action was right for the meaning of the novel verb. Only Akhtar and Tomasello (1995) have examined the child's ability to use pragmatic cues to determine whether a novel label should refer to an object or action. Their results showed that children learned the new word as referring to whichever was newly added to the discourse context at the time of naming. And the children who saw the action preparation learned the new word for the action, whereas children who saw no preparation learned the new word for the object. It demonstrates that the intention to perform the target action in conjunction with the appearance of the novel word made it easier for young children to acquire the action-label mapping.

As mentioned above, Mandarin-speaking children are more likely to generalize a bare word which was presented without any syntactic structure to new events with similar objects, which suggests there's a natural tendency to link a novel word to the object instead of the action. In Imai et al.'s studies (2008), Chinese children were extremely sensitive to subtle contextual cues, in that only when the object was deemphasized would they map a novel verb to the action. Study 1 examined whether young children use pragmatic information in their early word learning to decide whether the referent of the label should be an object or action.

The training procedure in Tomasello and Akhtar (1995) was adopted in the present study. In their test of children's understanding, children were asked to provide manual responses, such as performing the target action or selecting the target object. Differed from their measurement, a "looking-while-listening" methodology was used to measure young children's comprehension of the novel words in the current test. This procedure is low in task demands and captures nuanced picture of young children's developing skill in finding meaning in spoken language, because response latencies can be coded with millisecond precision on multiple trials over multiple items (Fernald, Zangl, Portillo, & Marchman, 2008). Comprehension occurs rapidly and

automatically without time for reflection, it is revealing to study the listener's interpretation during speech processing and not just afterward.

In the learning situation the toddlers heard a novel word in the presence of a nameless action performed on a nameless object. The pragmatics of the situation was manipulated by introducing a new element, object, or action, to the discourse context. The hypothesis was that young children know that adults are more likely to use novel language to indicate the element that is new to the current discourse background. In the Action-Novel condition the action was the new element to the discourse context, whereas in the Object-Novel condition the object was new to the discourse context. The introduction of the new elements was carried out by another experimenter (not the actor) in the video by pointing and exclaiming at the time when the new objects or actions were being added to the scenario.

Method

Participants

Twenty-eight children (15 boys) with a mean age of 24.12 months (range: 23.50-24.57, *SD*=.27) were included in the final sample. All were recruited from Hong Kong through a post on the internet of local child-rearing forum and were acquiring Cantonese as their native language. They were voluntary to come to participate and provided with reimbursement for their travel expenses. Infants were mostly from middle-class families. Parents completed the Cantonese Communicative Development Inventory-Short Form Level II (CCDI; Tardif et al., 2008) which measured the early language development of word production in young children. Infants' mean production vocabulary was 67 out of 133 words (ranging from 20 to 133); there were no differences in the vocabulary measures among different test conditions. An additional 2 infants were excluded due to general fussiness and low

language ability (CDI<5%). Basic demographic information was obtained via a short questionnaire prior to testing.

Materials

Visual stimuli

I used digitized video recordings of live actors performing a series of continuous actions on inanimate objects as visual stimuli. These recordings were edited to create the series of action sequences described in Table 1. These action sequences were approximately 1 min in duration and were presented to the toddlers against a white background on a 135 cm screen. Different sets of objects and actions were used in different trials (Appendix A).

Auditory stimuli

A female native speaker of Cantonese adopted an infant-directed speech register to produce the linguistic stimuli described in Table 1. Her utterances were recorded in a sound-attenuated booth and the timing, duration, amplitude, and pitch peaks were edited to be similar. Then the sound recordings were synchronized with the visual stimuli. The auditory stimuli were two-syllable pseudo-words. The individual syllables are existent in Cantonese however became meaningless in the combinations. During the test, the auditory stimuli were played via a hidden speaker centered behind the visual display.

Apparatus and procedure

The toddlers were tested individually in a quiet room with their caretakers' company. While they arrived to our laboratory playroom, the toddler got warmed up by playing freely with toys and the caretaker signed a consent form and completed the CCDI and a short demographic questionnaire. Then they were sent into a test room where the infant was seated 1.3m directly in front of the screen. The caretaker, seated beside the infant, was instructed not to talk or to direct the infant's attention. The

experimenter then moved behind the screen to start the experimental procedure. Throughout the test session, infants' looking behavior was recorded for subsequent coding with a video camera that was centered below the screen. The whole experiment session lasted approximately 10 min. The toddlers took a break after every 5 trials.

The procedure itself included two phases: a familiarization and a test phase (see Table 1). Each infant completed this two-phase procedure 10 times (trials). Each trial involved a different sequence of scenes (e.g., a man waving a fan, a girl tapping on a bottle). Five were Object-Novel trials and the other 5 were Action-Novel trials. See Appendix A for a complete description of the scenes depicted in each trial. A still photo of a smiling baby, accompanied by an audio track of an infant giggling, was shown at the center of the screen at the beginning of each trial to capture infants' attention,. The presentation orders were counterbalanced across subjects using a Latin square design. The left-right position of the familiar and novel test scenes was counterbalanced across trials.

Table 1. Representative set of stimuli in Study 1 and predicated response pattern in each condition

Condition	Familiarization (*3)	*Test*	
		Familiar Scene	*Novel Scene*
Object-Novel	Video: Man waving board candy toy, then waving fan	Man waving fan	*Man waving balloon (Object-different)* *Man tapping on fan (Action-different)*
	Audio: [bit1-dak1]	*Baseline: "Look, they're different!"* ***(Look more at novel scene)*** *Test: "Where's [bit1 dak1]?"* ***(Look more at familiar scene at Object-different; Maintain preference over novel scene at Action-different.)***	

	Woman twirling umbrella on the shoulder, then spinning umbrella on the floor	Woman spinning umbrella on the floor	*Woman spinning broom on the floor (Object-Different) Woman pound floor with the umbrella (Action-Different)*
Action-Novel	*Audio: [taam1 gok3]*	*Baseline: "Look, they're different!" (Look more at novel scene) Test: "Where's [taam1 gok3]?"* ***(Look more at familiar scene at Action-different; Maintain preference over novel scene at Object-different.)***	

Familiarization phase

Infants saw the same familiarization event three times, presented one at a time on the left, right, and center section of the screen. In the Object-Novel condition, the actor (e.g., a man) performed a particular action (e.g., waving) on an object (e.g., an empty bottle) and another experimenter sat besides the actor. Through the loud speaker the infant heard a novel word (as a two-syllable utterance, e.g., /bit1-dak1/ [1]) which was synchronized as produced by the other experimenter just when the same action was performed on a new object (target, e.g., a small round ball). In the Action-Novel condition, the actor first did something with the object, and then, just as a new action was being performed with this same object, the other experimenter pointed and said "Look! 'bit1-dak1'!".

[1]The Cantonese sound samples used in this article are transcribed in "Jyutping," or "Cantonese Romanization," standardized by the Linguistic Society of Hong Kong (1993). Numbers indicate lexical tones. Detailed descriptions of the system are available at http://en.wikipedia.org/wiki/Jyutping.

Test phase

Two test events were presented simultaneously on the left and right section of the screen. The pairs of the two test events varied as a function of between-subject condition: Object-Different, and Action-Different. In the Object-Different test condition, both scenes featured the same action as in familiarization; what varied between them were the objects involved. The familiar test scene included the target object as in familiarization. A new object which was never shown in familiarization was used in the novel test scene. In the Action-Different condition, the object between the two scenes was same as the one appeared in familiarization while the actions performed onto this object differed. A novel action which was never seen in the familiarization was performed in the novel test scene while in the familiar test scene the target action was performed.

The test phase was divided into two distinct periods, baseline and response. In the baseline period, the toddlers in all the conditions saw the two test scenes accompanied by the same audio ("Look. They are different."). By checking the baseline preference for the two test scenes, it provided an implication whether the toddlers had processed the events in familiarization and noticed what's new in the test scenes. This period lasted for 6s. In the response period, toddlers' response to the test question (e.g., where is /bit1-dak1/?) reflected their comprehension of the novel word. Actually the participants were asked which of the two events best represented the target word. The test period lasted for 8s.

Coding

The videotaped experiment sessions were coded off-line with the test scenes removed to ensure that the coders were blind to condition assignment and the right-left position of the novel and familiar test scenes. Coders identified for each frame (15 frames within 3 s), whether the toddler's eyes were oriented to the left

scene, the right scene, or neither scene.

Two windows, one from the baseline period, and another from the response period were selected to observe the toddlers' response. The baseline window included the last 3s of the baseline period. The response window consisted of 3 s which began with the end of the novel word. Within each window, I calculated for each infant and each trial, the mean proportion of looking time devoted to the familiar test scene. To be specific, it was the total time accumulated looking toward the familiar test scene divided by the total time accumulated looking toward both the familiar and novel test scenes. A primary coder coded all of the participants. A second coder independently coded 25% of the randomly selected toddlers. Agreement between the two coders reached 90%.

Design & Predictions

In this study, each toddler received 5 Object-Novel trials and 5 Action-Novel trials. The subjects were randomly assigned to either the Object-Difference or Action-Different test condition. In each test, there were both baseline and response windows. If the toddlers were sensitive to the consistent events in the familiarization, they should detect the novel element (either object or action) in the novel test scene, and should therefore reveal a strong preference for the novel test scene in baseline window.

If the toddlers had distinguished understanding of the novel words as verbs versus nouns, their performance in the response period should vary systematically as a function of the test condition (Action-Different versus Object-Different). If they expect the novel words refer to the target action in Action-Novel condition, then in response to the test question ("Where is /bit1-dak1/?), they should search for the familiar event, directing their attention away from the novel test scene and toward the familiar test scene when the two scenes differed in the actions performed. However

when the two scenes both included the same action events, toddlers could reasonably maintain their focus on the novel test scene. If the toddlers expect that the novel word refer to the target object in Object-Novel condition, they should have shifted their attention from novel test scene to familiar test scene which differed in the objects and instead maintained their attention on novel test scene when they share similar objects with the familiar scenes.

In the Object-Different test, the familiar and novel test scenes portrayed the very same event types, differing only in the object on which the action was performed (the event participants). Both test scenes could be taken as a correct extension of the novel verb while only the familiar scene represented the meaning of the novel noun. In the Action-Different test, only the familiar test scene was correct for the novel verb and both test scenes had the right meaning for the noun. If the preference over familiar scene only exists in Action-Different test but not Object-Different test, it shows that toddlers' representations of the verbs are abstract, permitting them to apply a newly-acquired verb to events that involved different participant objects.

Results

For each child, a proportion of looking time was calculated by dividing the number of frames (15 frames within 3 seconds) spent looking at the familiar scene by the number of seconds spent looking at both the novel and familiar scenes. Thus, any value significantly greater than .50 indicated a preference for the familiar scene. This proportion was calculated for the baseline and test trials across all the conditions. Preliminary analyses indicated that neither gender nor object sets had a significant effect on proportion looking. Therefore the data across object sets and gender were pooled. The theoretical issue under investigation is whether the infants' performance would change as a result of introducing the novel label in the different pragmatic contexts, adding a new object or performing a new action.

If the infant looked at neither the left nor the right scene over half of the baseline or response period, the data were discarded. Any score that were more than 1.5*IQR from the rest of the scores were also discarded. IQR stands for "Interquartile range".

Table 2. The mean proportion looking at the familiar scene in Study 1

Video condition	Test condition	Window	*Mean* (*SD*)
Action-Novel	Action-different	Baseline (*N*=8)	.34(.18)
		Test (*N*=8)	.50(.06)
	Object-different	Baseline (*N*=15)	.50(.14)
		Test (*N*=15)	.45(.15)
Object-Novel	Action-different	Baseline (*N*=11)	.50(.12)
		Test (*N*=11)	.70(.08)
	Object-different	Baseline (*N*=14)	.51(.13)
		Test (*N*=14)	.54(.14)

Eyeballing the means reveals that, first, during the baseline period, infants in all the conditions preferred the novel test scenes or paid equally attention between the novel and familiar scene (all the mean $\leqq$.50). This suggests that 24-month-olds in all the conditions were sensitive to the actions and objects portrayed throughout the dynamic familiarization scenes, and therefore detected a change in the event, even when the very same objects or actions were involved. Second, during the response period, performance among the conditions began to diverge, with toddlers in different video conditions demonstrating different patterns of test by window interactions. In the following ANOVA analyses, I would separate the Action-Novel and Object-Novel as two independent conditions to examine the effects of Test Conditions and Test Windows.

ANOVA for Action-Novel

I analyzed the proportion of looking time devoted to the familiar scene with Test Condition (2: Action-different, Object-different) as a between-subjects factor and Window (2: baseline, response) as a within-subjects factor. This analysis revealed a Window by Condition interaction effect, $F(1,21)=5.708$, $p<.05$, $\eta^2=.214$.

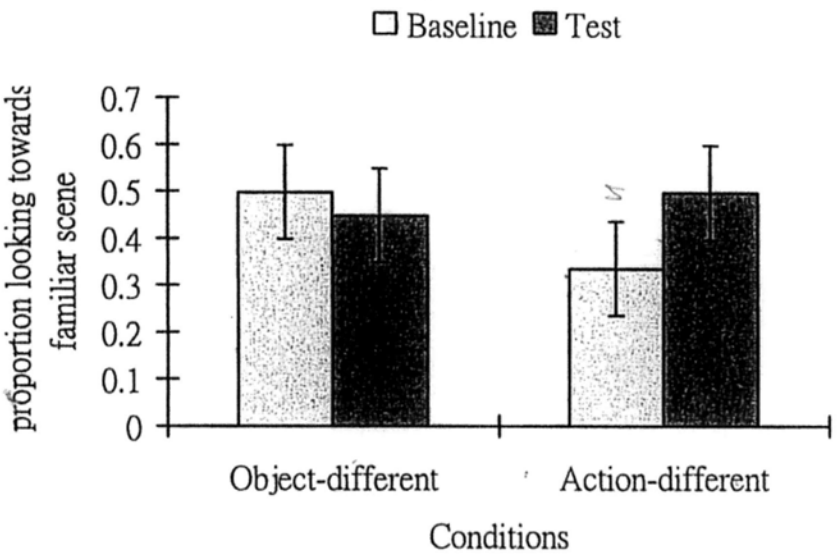

Fig.1. Study 1. Mean proportion of looking time towards the familiar test scene in the baseline and response windows of Action-Novel, expressed as a function of Test Condition

I therefore used planned comparisons to compare infants' performance in the baseline and response windows in each test condition. As predicted, infants in the action different test shifted their attention significantly from the novel scene in baseline to the familiar scene in response to the novel word (M=.33 and .50, respectively), $t(7)=-2.806$, $p<.05$. However, infants in Object-different test condition performed comparably in the baseline and response windows (M=.50 and .45, respectively). This is an important finding because it indicated when the very same action was presented in the test, toddlers' preference for the novel test scene persists throughout the response window. While the actions in the test were different between the novel and familiar scene, infants looked reliably longer at the familiar scene in

response to the novel word than in the baseline window.

I next asked whether the distinct patterns of performance observed within each condition were reflected in the behavior of most toddlers within that condition. I tallied the number of children in each condition whose mean looking time to the familiar scene in the response window (averaged over all trials) exceeded that in the baseline window. In Action-difference condition, 87.5% of the children (7 out of 8) looked longer at the familiar test scene in the response than the baseline window, a distribution that differed from chance, $\chi^2(1)=4.50, p<.05$. In contrast, the number of infants displaying this pattern in Object-different test condition (6 out of 15) did not differ from chance, $p>.50$. Thus non-parametric analyses echo analyses based on group means, suggesting that the mean patterns within each condition characterize well the behavior of its individual participants.

ANOVA for Object-Novel

As in the above, I submitted the proportion of looking time devoted to the familiar test scene to an analysis of variance with Test Condition (2: action different, object different) as a between-subjects factor and Window (2: baseline, response) as a within-subjects factor, and used this to test my predictions in the Object-Novel scenario. See Fig. 3. This analysis revealed a main effect for Test Condition, $F(1,23)=5.356, p<.05, \eta^2=.189$; infants in the action different test looked reliably longer at the familiar test scene ($M=.602$) than did those in the object different test ($M=.525$). There was also a main effect for Window, $F(1, 23)=10.187, p<.05, \eta^2=.307$; infants looked reliably longer at the familiar scene in the response window ($M=.621$) than in the baseline window ($M=.506$). The Condition by Window interaction was also significant, $F(1, 23)= 5.154, p<.05, \eta^2=.183$.

To explain the interaction effect, planned comparisons were conducted to compare toddlers' performance in the baseline and response windows in each

condition. Different from prediction, the patterns of toddlers' responses for Object-novel condition were similar as those in Action-Novel condition. In the object different test they performed comparably in the baseline and response windows (M=.51 and .54, respectively), $t(13)$=-.632, p=.538. This suggests that toddlers' preference for the novel scene persists through the response window. So the toddlers might not have noticed that the target object in the familiar test scene was what the novel word referred to. However, this shift in attention from the baseline to the response window was evident in the action different test (M=.50 and .70, respectively), $t(10)$=-4.274, p<.05. This suggests that when the novel word appeared with two scenes which differed in actions only, toddlers tended to match the word with the familiar action scene. Thus the same conclusion might be drawn as in the Action-Novel case that toddlers tended to interpret the novel words as referring to the action instead of the object while the latter should be a target referent during the discourse context.

A non-parametric analysis of individual infants' patterns of performance revealed that the distinct patterns observed within each condition were reflected in most infants within that condition. In the action different test, 82% of the infants (9 out of 11) looked longer at the familiar test scene in the response than the baseline window, χ^2 (1)=4.50, p<.05. In contrast, 65% of the infants (9 out of 14) display this pattern in the object different test, p>.30.

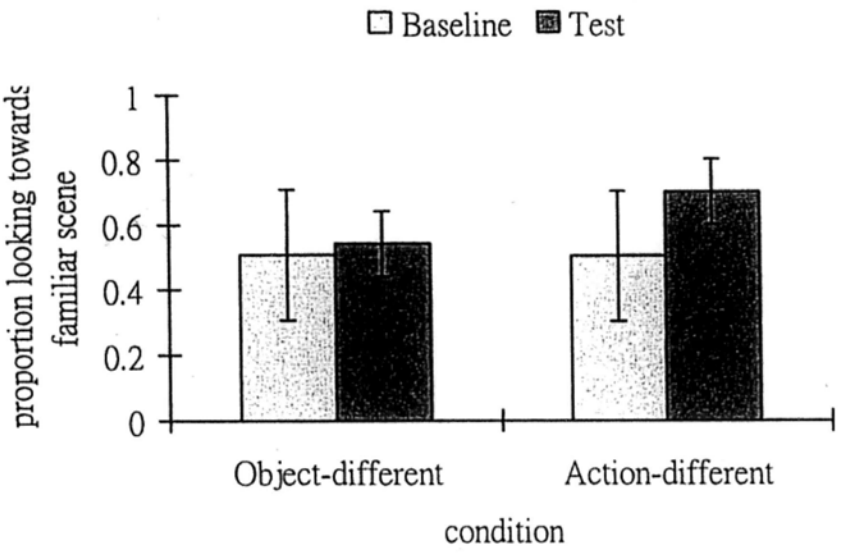

Fig.2. Study 1. Mean proportion of looking time towards the familiar test scene in the baseline and response windows of Object-Novel, expressed as a function of Test Condition

Discussion

The findings of this study offer three insights into the word learning capacities of 24-month-old toddlers in pragmatic discourse context. First, toddlers' performance in Action-Novel learning reveals that they detected the change of action in the discourse context corresponding with the novel word and successfully mapped this word to the target action only. Secondly, the toddlers' representation of the novel verb was abstract enough to permit them to extend the verb beyond the particular action-object pairing with which it had been introduced. Thirdly, their failures in the Object-Novel learning condition suggested that they focused more on the action performed onto two different objects and mapped the novel word to this action even though they heard the word at the moment of object change.

According to the hypothesis, when children heard a novel word used in conjunction with a nameless action being performed with a nameless object, with no morphological or syntactic cues available, they would learn the new name as referring

to whichever element that was new to the discourse context. The results only showed this learning effect in the Action-Novel but not the Object-Novel condition.

The current findings demonstrate that verb learning can be driven by non-linguistic knowledge. Young children map novel names to actions previously singled out by an adult and are sensitive to actions being singled out via ostensive naming (Akhtar et al., 1996), salient activities (Samuelson & Smith, 1998) or speakers' intention to refer to them (Tomasello & Akhtar, 1995). Novelty to the discourse context was found to be a powerful cue in children's early language learning (Horst, Samuelson, Kucker, & McMurray, 2011). There is considerable evidence from early infancy that novelty plays a role in driving attention. For example, 2-month-old infants' looking at familiar stimuli decreased across successive trials as the stimuli became more familiar (Fantz, 1964), and from 7 months on infants reach more for novel than familiar objects (Shinskey & Munakata, 2005). Other studies suggest that children take novelty relative to a speaker into account in referent selection. For example, children take adults' excitement as an indication of what is the most novel in the context and is therefore more likely to be the referent of a novel word (Tomasello & Haberl, 2003). On the basis of these data, it is argued that novelty serves as a social pragmatic cue in naming contexts.

In toddlers' mapping of concepts to real-world events, the ability of event segmentation might lay the groundwork for extracting actions from the event stream and conceptually mapping novel verbs to these actions. Event segmentation is likely guided at fine level by spatial perception and at a coarse level by social-cognitive processes (e.g., the attribution of goals and intentions). Research has shown consistently that infants are sensitive to intentional cues to segmentation and parse continuous motion. In the current learning situation, the actor continuously performed two distinctive actions on the same novel object. The successful word-to-action

mapping reveals that toddlers reliably map a novel verb to its referent when intentional cues were presented concomitantly with the verb. The notion that attention to event dynamics contributes to verb mapping is supported by the present observation.

Contrary to my prediction, younger children in the Object-Novel condition failed to direct their attention to the familiar scene in the Object-Different test but shifted their attention more to the familiar scene in the Action-Different test. It indicates that they did not use social cues to capture the referent for the new name at the time a new object was introduced to the context. Moreover, they seemed to interpret the word as depicting the action performed onto two consecutive objects. This findings contrast with previous evidence that social information plays a role in noun acquisition (e.g., Akhtar et al., 1996; Liebal, Behne, Carpenter, & Tomasello, 2009; MacPherson & Moore, 2010). For example, when Booth, McGregor, and Rohlfing (2008) showed children an array of objects, the noun-referent relation was learnt most reliably when intention cues were presented in conjunction with a label.

Note that I am not denying that children are capable of pragmatic inference nor that novelty plays a role in both noun and verb learning. To explain the failure of noun learning, we need to consider the design feature of the familiarization phase. In the Object-Novel condition, the two objects both appeared at the beginning of the session and remained throughout in the context. Even though at first the experimenter was engaged with one of them by acting out a particular operation, the other object was already in sight. When the actor dropped the current object and picked up the other one to perform the same operation, the experimenter pointed at this change of movement and said the novel word. Strictly speaking, this target object was not that 'new' to the speaker. Moreover, it may highlight the event category in this situation by giving two examples of the target action. This finding provides evidence that multiple

exemplars have a facilitative effect in verb learning.

In the present study, 2-year-old children benefit from viewing two exemplars of an action. This is consistent with the evidence that seeing more than one exemplar allows children to detect the invariant relation between actions in different contexts (Gentner, 2003). This facilitation effect is special in verb learning because unlike nouns, verbs are inherently relational as some action is performed on an object. One of the major stumbling blocks for children learning and extending new verb labels is their focus on the objects involved in the action and the neglect of the relation between them (Behrend, 1990; Forbes & Farrar, 1993; Gentner, 1988; Kersten & Smith, 2002). Behrend (1990) found that 3- and 5-year-olds were less likely than adults to extend a novel verb label to an action that included an instrument change. One theory suggests that children require multiple different exemplars to learn an action label. According to Gentner (2003) and Smiley and Huttenlocher (1995), children's initial word meanings are bound to specific objects and actors. Upon hearing a shared label across exemplars, children make comparisons and then uncover the relational commonality to which the label refers. Evidence shows that this may be even more important in the acquisition of verbs than in the acquisition of nouns (Gallivan, 1987; Hoff & Naigles, 2002; Rinaldi, Barca & Burani, 2004; Sandhofer, Smith & Luo, 2000). It seems necessary for children to use multiple instantiations of an action with a common label to correctly abstract and extend a novel verb.

The current experiment also shed light on the precision and breadth of infants' expectations for the meaning of novel verbs. Golinkoff et al (1995) proposed a lexical principle of extendibility in young children's action verb generalization. Extendibility for verbs refers to infants' ability to abstract the 'shape' of an event and then extend the verb labeling that event to new instances based on the abstracted 'image'. It enables infants to abstract the invariant shape components necessary to verb meaning.

Especially in the present study I tested verb generalization ability since in the test the target action was performed on a different object from the familiarization.

Consider the structure of the test trials presented in the current tests. One familiar scene and one novel scene were used simultaneously. The familiar test scenes included exactly the same objects and actions as in the familiarizations, while the novel test scenes had either the object or the action changed to be a novel one that were never shown in the familiarizations. The fact that children in the two test conditions had different responses argues that the experimental subjects did indeed learn the new word and that there were no artifactual aspects of the experimental setup that somehow led children to choose the target object or action in the comprehension test. The significant differences between the two test groups in the predicted directions in the Action-Novel scenario argues that the manipulation of novelty about the action was indeed the effective variable that influenced children in their interpretation of the adult's referential intentions. It showed 2-year-olds can successfully learn the novel word for the action as the experimenter has the intention to name the new elements in the context.

To summarize, the current experiments documents 2-year-old infants' ability to acquire the meaning of a novel label in the social context. Using the reference of new elements in the discourse context, infants learn to represent the verb meanings. And the finding that children learned the novel label as referring to the action in Novel-Object condition support that dynamic examples of the event also facilitate their verb learning.

Study 2 Use of linguistic cues-quantifiers and auxiliaries in novel noun and verb learning

Experiment 1

Research is accumulating to suggest that linguistic information can bias children's attention onto specific aspects of events. For example, Naigles and Kako (1993) demonstrated that before the age of 30 months, children can use syntactic information, particularly that encoded in the transitive verb frame, to redirect or refocus their attention on a less favored action (e.g., a causative action), thereby leading to successful mapping. Similarly, when Maguire (2004) offered her participants multiple exemplars (e.g., Starry spinning over, under, past, around the ball) and additional syntactic information in the form of a prepositional phrase (e.g., "Starry's moding over the ball"), they also redirected their attention to the less-favored action component (manner). Behrend et al. (1995) showed that children can easily apply the progressive –ing inflection to verbs denoting actions and the past –ed inflection to verbs denoting results of events. Thus such inflections in English guide children initial mapping of novel verb meanings. All these evidence converge to the theory of syntactic bootstrapping. Because the same scene can support any number of possible interpretations for a given verb, and the syntactic frame in which the verb is placed helps the child target the speaker's intended interpretations.

The key linguistic property that sets Chinese apart from English is the lack of morphological distinction between nouns and verbs. Granting that Chinese does not have muoh syntactic variation regarding verbs, Chinese children may be at a serious disadvantage relative to English-speaking children who can exploit the morphosyntactic inflection that is usually present in English for learning and extending a novel verb. Lee and Naigles (2005) argue that syntactic bootstrapping is possible in Mandarin Chinese because children hear verbs in multiple sentence frames

and can rely on regularities in how verbs are used syntactically.

Linguistic cues such as aspect-marking auxiliaries that accompany verbs (e.g., "zai" for progressive, "le" for perfective) are salient cues of verbhood to adults but they are not inherent to the word nor are they obligatory. It is not sure whether younger children can make use of these linguistic cues. Based on previous review, learner's prior probabilities with linguistic exposure can affect what kind of linguistic cues are being used to interpret a new word (Chater & Manning, 2006). In Mandarin and Cantonese, the position of modifiers can distinguish a noun and a verb. Usually the modifier is placed before the noun while it is more likely to put after the verb. There are also particular words to mark a noun and a verb, e.g., **/jat1-go3/** (a/one), **/ne1- go3/** (this), **/gwo2-go3/** (that) are usually followed with a noun in Cantonese and **/gan2/** (-ing), **/zo2/** (have been done) consistently appear after a verb. Given that Chinese children receive less systematically syntactic cues in terms of the absence of morphological marking on verbs and the occasional absence of argument structure, it is particular interesting to see whether the modifiers or aspect-marking auxiliaries of a word is strong enough to decide the reference of objects or actions.

According to a corpus of Cantonese speaking children, they have well mastered the quantifier and aspect-markers at the age of 2 (Lee, Wong, Leung, Man, Cheung, Szeto, & Wong, 1994). In the present study, I examined how morphosyntactic cues affect novel verb learning. Chinese provides an interesting test case for how the absence of argument structure influences object versus action word mapping because the words without morphology are ambiguous with respect to form class. If Chinese children do manifest a noun advantage, this will provide strong support for the view that universal cognitive factors are more prominent than language-specific factors in influencing the ease with which children learn novel words. The data will also illuminate the role of syntactic cues in novel verb learning. The novel word will be

presented as a bare word, a noun preceded by a quantifier, and a verb followed by an aspect-marking auxiliary. The bare word condition provides an ideal case to address whether young Chinese children have a predisposition to name a novel object rather than a novel action when no grammatical cues are available. If Chinese children map the novel label in bare word form to the object rather than the action, it suggests that children's tendency to learn the name of objects over action is independent of the frequency of verbs in the linguistic input which is revealed by checklist data (Tardif, Gelman, & Xu, 1999). On the other hand, if Chinese children map the bare word to the action or have no preference for either types of naming, it suggests that the input language indeed plays an important role in early process of word acquisition.

Methods

Participants

Forty-four children (30 boys) with a mean age of 24.03 months (range: 23.47-24.60, *SD*=.29) were included in the final sample. All were recruited from Hong Kong through a post on the internet of local child-rearing forum and were acquiring Cantonese as their native language. They were voluntary to come to participate and provided with reimbursement for their travel expenses. Infants were mostly from middle-class families. Parents completed the Cantonese Communicative Development Inventory-Complete Form Level II (CCDI; Tardif et al., 2008) which measured the early language development of words production in young children. Infants' mean production vocabulary was 327 out of 800 words (ranging from 32 to 775); there were no differences in vocabulary measures among the Bare Word, Noun and Verb conditions. Data from an additional 9 infants were discarded due to the failure to record their responses during the test.

Materials

The audio and visual materials were created in the same way as in Study 1. The contents of the video and sound stimuli varied. The video recorded an actor performing continuous actions on inanimate objects. One example of the actions was a man was waving a balloon. Children saw four different examples of a given event category, presented one at a time on either the left or the right sides of the screen. In each scene of the trial, same action was performed on one of four objects which differed in appearance but obviously from the same category (e.g., balloons of different shapes and colors). These recordings were edited to create the series of action sequences described in Table 3.

When playing the video, children hear the presentation of the novel word which varied as function of condition. The linguistic stimuli were described in Table 1. The auditory stimuli were two-syllable pseudo-words embedded in three linguistic forms, which varied as function of condition (Bare Word, Noun, and Verb). In the Noun condition, children heard a native Cantonese-speaking female utters when watching the event, "jat1 go3 (a) /bit1-dak1/ hai6 dou6 (is here)". In the Verb condition, the word was presented as in "hai6 dou6 (is) /bit1 dak1/ gan2 (-ing)". In the Bare Word condition, only the novel word /bit1- dak1/ without any syntax was presented. These sound recordings were synchronized with the same visual stimuli.

Apparatus and procedure

This was identical to Experiment 1 except that the stimuli were different and each child completed 5 trials of Object-Different test and 5 trials of Action-Different test in either one of the three label conditions.

Table 3. Representative set of the stimuli presented in Study2 and the predicted response pattern

	Condition	Familiarization	*Test*	
			Familiar Scene	*Novel Scene*
Video		A man waving balloon (four consecutive exemplars)	Man waving balloon	*Action-Different test: Man tapping balloon*
				Object-Different test: Man waving fan
Audio			*Baseline: "Look! They are different."*	
	Verb	"keoi5 hai6 dou6 /bit1-dak1/ gan2" (he is bit1 dak1 ing)	*Response: "bin1 go3 hai6 dou6 /bit1-dak1/ gan2 "(which one is bit1-dak1 ing?)* ***(Look more at familiar scene than novel scene in Action-Different test only, while not in Object-Different test)***	
	Noun	"jau5 jat1 go3 /bit1-dak1/ hai6 dou6" (there is one bit1 dak1)	*"bin1 go3 hai6 gwo2 go3 /bit1-dak1/" (which one is the /bit1-dak1/?)* ***(Look more at familiar scene than novel scene in Object-Different test only, while not in Action-Different test)***	
	Bare Word	"/bit1-dak1/"	*"bin1 go3 hai6 /bit1-dak1/? (which one is /bit1-dak1/?)* ***(If similar to Noun condition, suggests an advantage in noun learning)***	

Coding

This was identical to Study 1. Agreement between coders for the response windows was 91%.

Design & Predictions

In this study, the infants were randomly assigned to Bare Word, Noun or Verb condition. Each infant received 5 Object-Different tests and 5 Action-Different tests. In each test, there were both baseline and response windows. If infants are sensitive to the consistent events in the familiarization, they should detect the novel element

(either object or action) in the novel test scene, and should therefore reveal a strong preference for the novel test scene in baseline window.

If infants had distinguished understanding of the novel words as verbs versus nouns, their performance in the response period should vary systematically as a function of the test condition (Action-Different versus Object-Different). The two scenes in Action-Different tests distinguish in the actions depicted. In familiar scene, the action is the same as in the familiarization while a novel action is involved in the novel test scene. Note that to succeed at this task, toddlers in the Verb condition have to accept an event that preserved the action, despite a change in objects, and those in the Noun condition have to accept an event that preserved the object, despite a change in the action in which it was involved. If children expect that verbs refer to the action, then during familiarization they should map the novel verb to the event category and not to the objects that is acted on. If this is the case, the response to the test question should be directed to the familiar event. Compared with baseline period, the attention toward familiar test scene is increased. In the case of Noun condition, if the children realize the novel noun refers to the object category instead of the action, they should show no difference in the two scenes. There is smaller change from baseline to response period in terms of the proportion looking time of familiar event.

Recall in the Object-Different condition, the familiar object appears only in the familiar test scene, and the familiar action now appears in both the novel and familiar test scenes. If infants expect that the novel word refer to the target object in Noun condition, they should have shifted their attention from novel test scene to familiar test scene which differed in the objects and instead maintained their attention on novel test scene when in Verb condition.

Bare Word condition was used to examine Chinese children's predisposition to name a novel object or a novel action. If the result for Bare Word Condition is similar

to Noun condition, it suggests Chinese children tend to map the novel word without morphosyntactic bounding to the object rather than the action. On the other hand, if Bare Word condition and Verb condition share a similar result patter, it suggests that the young children are willing to map the word to the action rather than the object.

Results

Preliminary analyses indicated that neither gender nor object sets had a significant effect on proportion looking. Therefore the data across object sets and gender were pooled. The theoretical issue under investigation is whether infants' performance would change as a result of introducing the novel label as a verb or noun, using aspect-marking auxiliaries and quantifiers. I compared the performance across the three conditions in two separate analyses. In the action different condition, preference over familiar scenes would indicate a word to action mapping. In Object-different condition, preference in looking would indicate matching the novel label to the object rather than the action.

Table 4. Mean proportion looking at the familiar scene in Experiments 1 of Study 2

Test condition	Label condition	Baseline Window *Mean* (*SD*)	Test Window *Mean* (*SD*)
Action-different	Noun (*N*=13)	.47(.14)	.44(.15)
	Verb (*N*=16)	.51(.17)	.51(.15)
	Bare word (*N*=10)	.41(.13)	.43(.13)
Object-different	Noun (*N*=13)	.45(.13)	.47(.19)
	Verb (*N*=17)	.36(.14)	.55(.17)
	Bare word (*N*=12)	.42(.19)	.49(.14)

To consider how they performed in Object-Different test, I submitted the proportion looking data of Object-Different to an analysis of variance (ANOVA) with Label (3: Verb, Noun, Bare word) as a between-subjects factor and Window (2: baseline, response) as a within-subjects factor. This analysis revealed a main effect for Window, $F(1,39)=7.169$, $p<.05$, $\eta^2=.155$; infants looked reliably longer at the familiar scene in the response window ($M=.51$) than in the baseline window ($M=.40$). Neither the Label main effect nor the Window X Label interaction was significant.

During the baseline period, only children in Verb condition exhibited a strong preference for the novel test scenes, $t(16)=-4.33$, $p<.01$. This suggests that 24-month-olds in Verb condition were sensitive to the objects portrayed throughout the dynamic familiarization scenes, and therefore detected a change in the event, even when the very same actions were involved. However, such patterns failed to emerge in the Bare Word and Noun conditions.

During the response period, infants in all the conditions directed increasingly more visual attention toward the familiar test scene. This suggests that infants' construals of these dynamic scenes were similar across the three conditions. They all linked the novel word to the objects even when they heard the novel word nested in verb syntax.

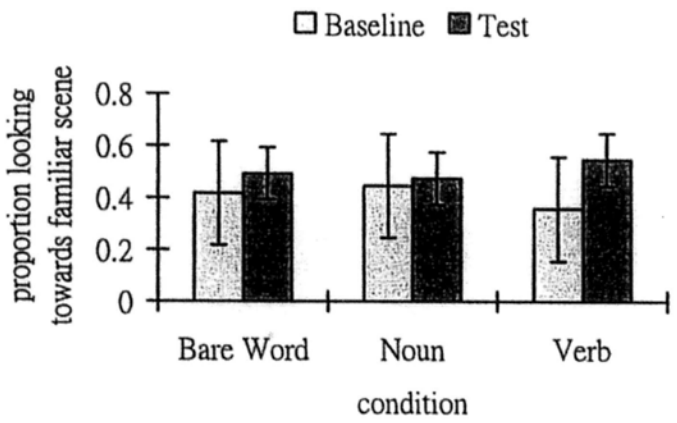

Fig.2. Study 2. Experiment 1. Mean proportion of looking time towards the familiar

test scene in the baseline and response windows, expressed as a function of Label condition in Object-Different test.

This time I looked into the Action-Different test and a same ANOVA analysis with Label (3: Verb, Noun, Bare word) as a between-subjects factor and Window (2: baseline, response) as a within-subjects factor were conducted. None of the effects was significant. This suggested that infants performed similarly in the baseline and response windows in all of the three Label conditions, not shifting their attention in response to any novel word. They failed to map the word with the action involved.

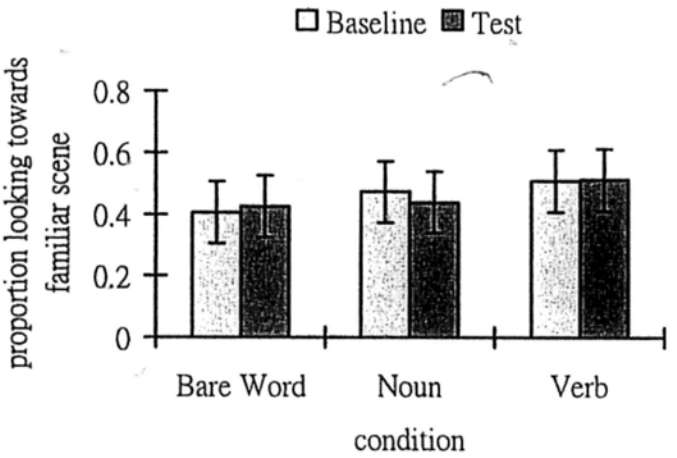

Fig.3. Study 2. Experiment 1. Mean proportion of looking time towards the familiar test scene in the baseline and response windows, expressed as a function of label condition in Action-Different test.

Discussion

The present study examined whether 2-year-old children learn novel nouns more readily than novel verbs and how the linguistic properties of Chinese influence their interpretation of the novel word. The finding indicates that children have a strong tendency to map a novel label to a novel object, whether the word was presented as a noun or a verb, or as a bare word, whose grammatical form class was not revealed.

There were two possible explanations. On the one hand, these results consistently support the view that children map novel nouns more readily than novel

verbs (Gentner, 1982; Golinkoff et al., 1992, 1996; Landau, Smith, & Jones, 1998; Imai, et al., 2005, 2006, 2008). The pattern of the result in Bare Word condition suggests that, given the choice, young children expect novel objects to be named over actions. When a novel word presented in the absence of syntactic support, Chinese children favored an object-name interpretation for a novel word. This might suggest a privilege in noun learning regardless of languages.

On the other hand, the present findings contrasted with the Study 1 results, in which verb learning was facilitated with the reference of the speaker's naming intention, even better than noun learning. In the literature, past studies using the same experimental design as Study 2 have documented that 2-year-old English children can successfully learn new verbs (Waxman, Lidz, Braun & Lavin, 2009). What's more, there is a common assumption in the literature that learning an argument-dropping language confers an advantage on verb learning (Choi & Gopnik, 1995; Gentner, 1982; Tardif, 1996). It seems that the linguistic properties of Chinese- argument dropping and morphological simplicity-do not necessarily lead to more readiness to map and extend novel verb in young Chinese children.

Why did Cantonese-speaking children fail to learn verbs in the present tasks, given that they already have many verbs in their vocabulary? What aspects of the task made it so difficult for Chinese children to learn novel verbs? The concern that children at this age cannot understand the sentence construction can be relieved. An examination of the Hong Kong Cantonese Child Language Corpus gives us a clear understanding of early grammar in Cantonese. The categories of classifiers, aspect markers, modal auxiliaries and sentence final particles are evidenced between 1 year 9 months and 1 year 11 months old. It also confirmed by the checklist of CCDI that the 2-year-old children already have a fully understanding of the classifier 'yat1 go3' and progressive marker 'gan2'.

Another concern is that Chinese children might be extremely sensitive to subtle contextual and linguistic cues. In the present test, the children were asked "which one was /bit1-dak1/ ing". In Chinese, the wording of "which one" in raising a question here implies that the answer should be directed towards the subject instead of the event. The question was more likely to be interpreted as 'who is /bit1-dak1/ ing' because "which" and "who" translate into the same Cantonese term. Given this, I think the poor performance of the 2-year-olds in the Verb condition could have been due to the way of asking the key question, which was misleading and might have biased the children to search for the agent to map the novel label. To test this possibility, in Experiment 2, the Verb condition was replicated in Mandarin-rearing 2-year-olds using where-question.

Experiment 2

Given the unexpected results from Cantonese speaking children, I tested Mandarin-speaking children to see how they would perform. Supposedly, Cantonese and Mandarin share most of their grammatical as well as lexical distributional properties (Hawkins, & Chan, 1997). In the verb without arguments, an auxiliary verb "zhe1"[2] after the target verb marks the progressive aspect and is usually used in expressing an ongoing action. And it is confirmed with the corpus finding that 2-year-old children would easily understand this construction. To exclude the misleading factor in Experiment 1, the question asked in the response period was changed to "where is XX (the target word)?"

Methods

Participants

Fourteen 24-month-olds (7 boys) with a mean age of 24.01 months (range:

23.98-24.05 *SD*=.03) were included in the final sample. All were recruited from Guangzhou, China through the local kindergarten system and community neighborhood. They were acquiring Mandarin as their native language. Some of them were using Cantonese at home as well. They were voluntary to come to participate and provided with reimbursement for their travel expenses. Infants were mostly from middle-class families. Parents completed the Putonghua Communicative Development Inventory-Short Form Level II (PCDI; Tardif et al., 2008) which measured the early language development of words production in Mandarin-speaking young children. Infants' mean production vocabulary was 71 out of 113 words (ranging from 38 to 92); there were no differences in vocabulary measures among the conditions. Data from an additional 3 infants were discarded due to their general fuzziness during the test.

Materials

The visual materials were identical to those in Experiment 1. The audio was recorded by a female native speaker of Mandarin. The linguistic stimuli were made of two-syllabic nonsense Mandarin words modified by aspect markers 'zheng4 zai4[2]' and 'zhe1'. An example is "ta1 zheng 4 zai4 /de2-bi3/ zhe1 (he is /de2-bi3/ ing)". Only Verb condition was examined in this sample. In the response period, they were asked "na3 li3 shi4 /de2-bi3/ (where is /de2-bi3/?)".

Apparatus and procedure

This was identical to Experiment 1 except that every child watched 10 trials of Verb condition only, among which 5 trials were Object-Different tests and the other 5 was Action-Different tests.

Coding

This was identical to Experiment 1. Agreement between coders for the selected

[2] This is Mandarin Pinyin system.

windows was 89%.

Predictions

The predictions follow the same logic as those in Experiment 1 (with reference to the Verb condition).

Results and discussion

Paired-sample t-tests were used to determine if the differences between baseline and test were significant in the Object-Different and Action-Different conditions. In the Action-Different condition, infants increasingly shifted their attention to the familiar scene from baseline (M=.41) to test (M=.51), $t(12)$=-2.455, p<.05. Infants maintained their preference for the novel test scene in the Object-Different condition, $t(12)$=-.581, p=.572. This suggests that two-year-old infants successfully learned to link and extend a novel word to the action.

Table 5. The mean proportion looking at familiar scene (N=13)

Test condition	Baseline Window *Mean (SD)*	Test Window Mean *(SD)*
Action-different	.41(.18)	.51(.18)
Object-different	.37(.10)	.41(.20)

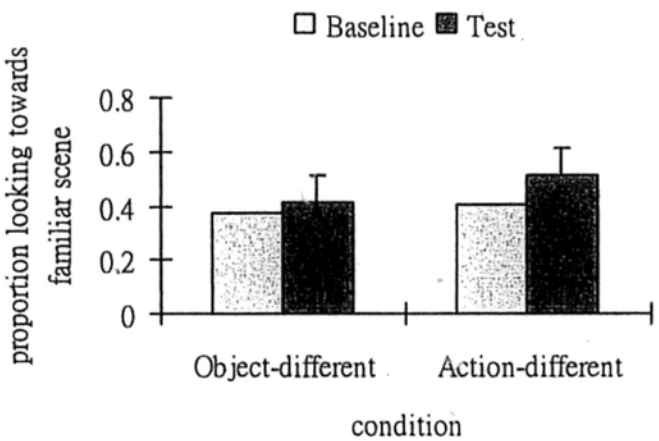

Fig.4. Study 2. Experiment 2. Mean proportion of looking time towards the familiar test scene in the baseline and response windows, expressed as a function of test condition

General Discussion

The results of these two experiments make three contributions to resolve the empirical and theoretical concerns in novel word learning. First, after 24-month-old infants view a series of dynamic scenes, they rather readily map novel label to a novel object (Experiment 1) or a novel action (Experiment 2). It provides evidence that children are not so captivated by the participant objects that the action in which they are involved go unnoticed. They are capable to direct their attention either to the action or the object according to the linguistic environment surrounding the novel word. Thus, 24-month-old infants are able to distinguish actions from their focal objects in dynamic scenes and distinguish novel verbs from nouns with morphosyntax. Most importantly, they treat these conceptual and linguistic distinctions as relevant to establishing the meaning of novel words.

Secondly, Chinese children were rather sensitive to grammatical cues in looking for the referent for a novel word. The specific question words used to elicit their response to the novel word could bias their search of the right answer. Children's performance of the three label conditions in Experiment 1 consistently showed an advantage in object naming and a failure to map the verbs to the actions. However, the results from Experiment 2 dismissed the noun bias account. Nouns are not inherently easier to acquire and extend than verbs because verb learning with the linguistic cues of aspect-marker modifiers was successful in Experiment 2. The poor performance in Verb condition can be simply explained by the inappropriate use of the question word, not a general noun bias.

Thirdly, these results suggest that 24-month-olds need rich scaffolding to extend a novel verb to a very similar event. In the present study, 24-month-olds received four different examples of the same action (e.g., in each example, the same actor was waving one of four different balloons) in association with a novel verb in the

familiarization phase. From the four examples, it is easier to extract the invariant action thus making the action more salient. With such rich scaffolding, 24-month-olds could extend a novel verb to a very similar event in which the same actor was performing the same action with the object from the same basic-level object category. The fact that children at 3 and 4 years of age still need some scaffolding in verb extension indicates that their understanding of verb meanings is not as robust as adults, and has room for developmental progress.

As discussed in Study 1, the current experiments suggest children's interpretations of the novel words were indeed abstract. Recall in Experiment 2 infants directed their attention away from the test scene depicting a novel action and toward the test scene depicting the familiar action in response to the test question. To determine whether infants had mapped the novel verbs narrowly by restricting their application to the same action-object pairing on which the verb had been introduced in familiarization, I looked into the results of the Object-Different test. The children did not direct their attention away from the test scene involving a novel object and toward the test scene that preserved the same action-object pairing as introduced in familiarization. The fact that they maintained their focus on the novel test scene suggests that they have sufficiently abstracted the meaning of novel verb beyond the particular action-object pairing with which it had been introduced.

To reconcile the successful verb learning in 24-month-old Chinese children with the difficulty to do so in 3- and even 5-year-old children (Imai, et al., 2005), several highlights about task differences were elaborated. It's not because children's success in verb learning is tied closely to the context in which transitive frames accompany causal events. Actually intransitive frames were used to describe a causal event in present study. In this study, the target verb was presented with argument dropped. This is a very natural situation for Chinese children, presenting a novel word as a verb with

the aspectual auxiliary but without the object argument. This evidence echoed with the claim that Chinese is a verb-friendly language since it allows pro-drop. So verbs often appear alone or in the utterance-final position, which occupies a more salient position than in the English SVO sentence (Slobin, 1973). Especially in the current study, using argument dropped sentence may be benefit for Chinese children acquiring the meaning of the novel verb by leading their focus onto the action itself and overcome the preoccupied attention on the participant object. It is common to see the object is usually dropped in everyday Chinese when the speakers are in the same dialogue context and assumedly share the same attention on the object.

Another possibility to reconcile the discrepancy is that the experimental design in present study is relatively easy to elicit children's correct responses. The test trials reported here included one familiar scene and one novel scene. The novel scene portrayed either a novel action or a novel participant object while the familiar scene was the same as what they saw in familiarization. The structure of the test trials in other investigation was more demanding in that both scenes included novelty. Children were required to choose between one novel scene (depicting a familiar action but a novel object) and another novel scene (a novel action on a familiar object) (Imai, et al., 2002, 2004, 2005; Kersten & Smith, 2002; Piccin & Waxman, 2007b).

Taken together, these findings reveal the impact of experimental design on our understanding of verb acquisition. The data filled in the gap between children's well-documented ability to acquire verbs in the natural course of their lives and their rather surprising failure to do so in many laboratory-based tasks. The current study shows that 24-month-olds' representation of word meaning is affected by the syntactic context in which the word appears. It is time to move beyond asking whether young children can or cannot represent verb meanings, and to consider instead the possible factors contributing to the acquisition of verb acquisition in young children.

Study 3 Verb learning with linguistic cues-word order

Consider a woman swirling an umbrella. When we watch this event, we see the elements of the event (woman, swirling, umbrella) simultaneously. But when we talk about the event, the elements are mentioned one at a time and in most languages, in a consistent order. For example, English, Chinese, and Spanish speakers typically use the order woman-swirl-umbrella [Subject-Verb-Object] to describe the event; Turkish and Japanese speakers use woman-umbrella-swirl. Word order is one of the earliest properties of language learned by children (Brown, 1973). In this study, I investigate how Chinese toddlers use word order as a syntactic cue to determine the grammatical category of a novel word.

Word order is particularly important in sentence interpretation in English, especially in the case of semantically reversible sentences such as "The girl pushed the boy" (Bates & MacWhinney, 1989). The importance of word order in Chinese children's early language acquisition is not yet fully examined. According to syntactic bootstrapping, word order is effective in cueing the meaning of a verb. A child learning the language of a specific community must therefore detect from linguistic input which is the prevailing basic word order in that community. A quantified study of written and spoken contemporary Mandarin found that Mandarin is a typical VO language (Sun & Givon, 1985). VO is the overwhelming order in both the written and spoken languages, which appears at the level of 90% and over, while the OV order is infrequent, at the level of 10% or less. In the current study, it is hypothesized that the common word order of Chinese is SVO and young children are sensitive to it.

Children's knowledge about the noun phrases in a sentence could also help their interpretation of the overall sentence structure. Owing to special learning problems for verbs that label dynamic events and processes, verb learner need to rely more on the syntactic structure in which new verbs appear, and pair this structural evidence with

the information present in the scene (Fisher et al., 1994). For the reason that it takes time to acquire structural knowledge and nouns can be efficiently acquired in the absence of such knowledge, nouns are always acquired earlier than verbs. What's more, an early understanding of nouns provides the foundation for the acquisition of the links between other grammatical forms and meaning (Gentner, 1982; Gleitman, 1990). Without access to the nouns, it should be difficult for learners to identify the arguments of a verb and therefore impossible to identify the event labeled by the verb in that context.

Based on probability, word order provides a cue for determining the form class of each word in the sentence. For example, if children understand the subject and object noun phrases in a sentence, they are likely to interpret the novel word placed between the two familiar nouns as a verb because of the dominant SVO order. But it is not the case if the novel word is in the position after the two familiar nouns because it is not common in Chinese that verb appears after two nouns. Even though the dominant type of word order is SVO in Chinese, variants of word such as OSV, SOV, and VOS sometimes appear. It would be difficult for young children at the early stage of language acquisition to interpret such sentences because they are not consistent with the canonical SVO word order which the children most frequently hear. In such cases, adding auxiliary words to mark the verb is helpful to identify new word's grammatical class.

In this study, it's examined how Mandarin-speaking children understand word order and auxiliary markers in verb learning, the result of which will shed light on syntactic bootstrapping in young Chinese learners. It is hypothesized that syntactic bootstrapping can even be used with languages that allow some argument dropping, such as Chinese, and overrides regularity in morphology for signaling verb meaning.

Experiment 1

In Experiment 1, the effect of word order was examined. Two objects were presented first in the scene. One of them was familiar to the children and the other was a novel object to them. It shows from CDI checklist that 30-month-olds have acquired the name of the familiar object, e.g., apple, airplane, etc. When the actor was engaged acting out a particular action on the familiar object with the novel one placed aside, the children heard two different types of sentences. The sentence types differed in the position of the novel word, with one being 'The man /de2-bi3/ (novel word) apple and the other 'The man apple /de2-bi3/". Performances in these two conditions were compared to see whether the children can use the sequence of how the word appears in the sentence to determine the referents of the novel word. It was hypothesized that when toddlers heard the novel word presented between two familiar noun phrases (verb position), they mapped the word to the action. When the novel word was uttered after two familiar noun phrases (ambiguous), it could be either interpreted as another noun phrase and mapped to the novel object in the scenario, or as a verb following the SOV order. It was hypothesized that children at this young age do not have much experience with the relatively rare SOV order. Hence in the ambiguous condition, they are less likely to link the novel label to the action than in the verb position condition.

Methods

Participants

Seventeen 30-month-olds (9 boys) with a mean age of 30.26 months (range: 29.5-21.8 *SD*=.56) were included in the final sample. All were recruited from Guangzhou, China through local kindergartens and the community neighborhood. They were acquiring Mandarin as their native language. Some of them were using Cantonese at home as well. They were voluntary to come to participate and provided

with reimbursement for their travel expenses. Infants were mostly from middle-class families. Parents completed the Putonghua Communicative Development Inventory-Short Form Level II (PCDI; Tardif et al., 2008) which measured the early language development of words production in Mandarin-speaking young children. The verbal subtests from the McCarthy Scales which measure the cognitive development were assigned to test the 2.5-year-olds' language ability. There were no differences in vocabulary measures and intelligence control among the conditions. Data from an additional 1 infant were discarded due to general fuzziness during the test.

Materials

In familiarization, Children saw an event sequence repeatedly for three times, presented one at a time on the left and right section of the screen. In each scene of the trial, the actor picked up the familiar object and performed a novel action on it. The novel object was also present in the scene but placed aside without the actor touching it. When playing the video, children hear the presentation of the novel word which varied as function of condition as mentioned above. The auditory stimuli were two-syllable pseudo-words embedded in two linguistic forms, verb and noun position. In the Verb position condition, children heard a native Mandarin-speaking female uttered while watching the event, "ge1ge1 /de2-bi3/ ping2guo3" (The man /de2-bi3/ apple). In the Ambiguous condition, the word was presented as "ge1ge1 ping2guo3 /de2-bi3/" (the man apple /de2-bi3/). Then the sound recordings were synchronized with the visual stimuli. The stops between words in both types of sentences were controlled to be equal.

In the test phase, two test events were presented simultaneously on either side of the screen. The familiar test scene depicted the same action and the same familiar object, with the novel object removed from the scene. The novel test scene included

the novel object in the familiarization however a different action was acted out on this novel one. The test phase included baseline and response windows. In the baseline period, the children heard "Look. They are different" designed to measure their basic preference for the two test scenes. In the response period, they were asked "Where is /de2-bi3/?" and their looking responses reflected their understanding of the novel words.

Apparatus and procedure

Infants and caretakers were invited to a psychology laboratory in the South China Normal University to participate in the experiments. The procedure was identical to Study 1 except that a practice trial was designed to familiarize the children with the test procedure before each session. The purpose of practice was to exclude the possibility that the children would take the stand-still object as irrelevant to the context and ignore it given that the action might be too attractive. In the practice trial, the children were clear about the names of the two objects and the action performed. Through the practical, children would pay attention to the object that was not the participant of the action and notice that it was likely to be mentioned in the discourse context and equally possible to be asked in the test phase.

Coding

This was identical to Study 1. Agreement between coders for the response windows was 88%

Design & Predictions

Each child finished 10 trials, among which 5 Noun position trials and the other 5 Verb position. In each trial of test, there were both baseline and response windows. If infants are sensitive to the consistent events in the familiarization, they should detect the different novel action in the novel test scene, and should therefore reveal a strong preference for the novel test scene in baseline window.

If the infants had distinguished understanding of the novel words as verbs or not, their performance in the response period should vary systematically as a function of the position condition (Noun position versus Verb position). If children interpret novel label placed between the two familiar nouns as a verb, then they should ignore the irrelevant object and map the novel label to the action in the familiarization. If this is the case, the response to the test question ("where is /de2-bi3/?") should be directed to the familiar event from the interests in the novel test scene in baseline period. If children do not treat the novel label appearing after two known words as a verb, they should remain their interest on the novel test scene when they hear the test question. There is no shift of attention between baseline and response periods.

Table 5. Representative set of the stimuli presented in Study3 and predicted response

<table>
<tr><th rowspan="2">Condition</th><th rowspan="2">Familiarization</th><th colspan="2">Test</th></tr>
<tr><th>Familiar Scene</th><th>Novel Scene</th></tr>
<tr><td></td><td>A man chopping apple with his hand, a nameless cupboard triangle placed on the desk (three consecutive exemplars)</td><td>A man chopping apple</td><td>A man circling the triangle on the desk</td></tr>
<tr><td>Verb position</td><td>"ge1ge1 /de2-bi3/ ping2guo3" (the man XX apple)</td><td colspan="2" rowspan="2">Baseline: "Now look they are different!"
(consistently looked at the novel scene)
Response : "na3li3 shi4 /de2-bi3/?"
(Where is de2 bi3?)
(looked more at the familiar scene than novel scene in Verb condition; but remained their interests on novel scene in Noun condition)</td></tr>
<tr><td>Ambiguous</td><td>"ge1ge1 ping2guo3 /de2-bi3/" (the man, apple, XX)</td></tr>
</table>

Results

To examine whether the position of the novel word in the sentence affected the infants' contruals, a repeated-measure ANOVA was conducted with Condition (2: Verb position, Ambiguous) and Window (2: baseline, response) as within-subjects

factors. This analysis revealed a main effect of Condition, $F(1, 15)=5.095$, $p<.05$, $\eta^2=.245$; toddlers in Verb position condition looked reliably longer at the familiar test scene ($M=.56$) than did those in Ambiguous condition ($M=.47$). There was also a main effect for Window, $F(1,15)=4.962$, $p<.05$, $\eta^2=.249$; toddlers looked reliably longer at the familiar scene in the response window ($M=.57$) than in the baseline window ($M=.46$). The Condition by Window interaction did not reach statistical significant, $F(1, 15)=.569$, $p=.462$, $\eta^2=.037$.

Table 6. The mean proportion looking at the familiar (action) scene in Experiment 1 & 2

	Baseline *M (SD)*	Response *M(SD)*
Verb position (N=16)	**.49(.18)**	**.63(.16)**
Ambiguous (N=16)	**.43(.24)**	**.50(.24)**
SVO-ambiguous(N=11)	**.36(.17)**	**.56(.15)**
SOV-ambiguous(N=11)	**.53(.12)**	**.45(.13)**

To test our predictions more directly, I used analyses of simple main effects. These analyses revealed that during the baseline window, there were no reliable difference among the condition, $t(15)=.764$, $p=.457$. As predicted, infants in the two conditions exhibited preferences for the novel test scene, in which a previous same object was included. Also as predicted, in the response window, reliable differences between the conditions emerged, $t(15)=2.262$, $p<.05$. Infants in Verb position condition devoted a greater proportion of looking time to the familiar test scene than did infants in Ambiguous condition. This suggests that infants shifted their attention from the novel scene to the test scene greatly when they previously heard the novel word presented in a verb order sentence. In contrast, they maintained their interests in the novel scene if the novel word appearing in an ambiguous position, after two nouns. It was possible that they mapped the label onto the unknown object in the context, the

one that was placed aside instead of the action. It shows that 2.5-year-olds can successfully use SVO word order as an effective linguistic cue to distinguish and learn the referents for verbs.

Discussion

Experiment 1 demonstrated the effect of the hypothesized SVO word order on toddlers' response to the test questions. First, toddlers in all conditions were sensitive to the novel actions and participant objects portrayed in the familiarization scenes and readily detected the novel elements in the novel test scene. Second, toddlers' differential performance in Ambiguous and Verb position offers insights into their representation of the meaning of the novel words. Toddlers in Verb position condition shifted their visual attention reliably from the novel test during the baseline window toward the familiar test scene during the response window, suggesting an action explanation of the novel word. This evidence showed that 2.5-year-olds fully acquired the SVO word order and applied the structure in novel word interpretation. Their attention to the familiar (action) test scene was higher than in the novel (object) test scene in Verb position only. And in Ambiguous situation, they focused more on the novel test scene which included the unnamed object in the previous discourse context. Thus it implies toddlers' tend to categorized the novel stimuli to be a noun by placing it after two named nouns. The response varied between these two conditions supports the hypothesis that the word order is closely related to children's interpretation of the novel labels.

The experiment provides an interesting finding that young children didn't use the SOV order to interpret the novel word. In Ambiguous condition, the novel word appeared after the two noun phrases. If children had used SOV word order, their performance should be similar to those in Verb position condition, shifting their

attention onto familiar scene from baseline to test windows. However the results indicated it was not the case. The present evidence appeared to be contrast with an argument that the SOV order governed prelinguistic communication (Langus & Nespor, 2010). The dominance of SOV order is attested in the gestural utterance produced by normally hearing English (SVO), Chinese (SVO), Spanish (SVO) and Turkish (SOV) speaking adults when instructed to use only gestures to describe simple scenarios (Goldin-Meadow, So, Ozyurek, & Mylander, 2008). It is believed that the different prominence of SOV and SVO orders among the world's language originated from different cognitive systems. The SOV is the preferred constituent order in the direct interaction between the sensory-motor and the conceptual system while the SVO order is preferred by the computational system of grammar. My result only focused on the grammar construction of word order and how children make use of their native language word order to interpret the novel word. Thus the result is consistent with the theory that SVO order is preferred in Chinese language acquisition situation. What's more, the participants in the present study was old enough to develop grammar. The age effect could probably be one of the reasons that explain why SOV was not popular with the participants.

Experiment 2

In Experiment 2, I pit modifiers against word order as cues for learning the grammatical category of a novel word. The results of study 2 strongly suggest that classify modifiers and aspect-markers are useful and applicable for Chinese 2-year-old children to distinguish nouns and verbs. Experiment 1 in the present Study has shown that the position of how the novel label appears in a sentence can determine Chinese children's interpretation of new words and SVO order is stable and acquired early in young children language acquisition. It would be interesting to

examine whether SOV would be a possible word order utilized by young children with the aid of linguistic cues, the aspect-marker to modify the novel word. I tested out two conditions in this experiment, SVO-ambiguous and SOV-ambiguous. In SVO-ambiguous condition, children hear the novel word appear between two known nouns and it is modified with by the quantifier "yi1ge4"(one), e.g., "ge1ge1 yi1ge4 /de2-bi3/ ping2guo3" (the man one XX apple). The novel word can be interpreted as a noun or an adjective. In SOV-ambiguous condition, the novel word was modified with a progressive aspect-marker "zhe1" and shown in the final of the sentence after the two know nouns, e.g., "ge1ge1 ping2guo3 /de2-bi3/ zhe1" (the man apple XX-ing). If the SOV is effective with the aid of verb modifier, children would interpret the novel label as a verb. The less preferred SOV order would become acceptable in Chinese language acquisition and guide children to map the novel label to the action in the same case.

Methods

Participants

Twelve 30-month-olds (7 boys) with a mean age of 30.03 months (range: 29.07-30.47 *SD*=.48) were included in the final sample. All were recruited from Guangzhou, China through the local kindergarten and community neighborhood. They were acquiring Mandarin as their native language. Some of them were using Cantonese at home as well. The stimuli and procedure were identical to Experiment 1 with one exemption that the audio stimuli were changed to be SVO-ambiguous and SOV-ambiguous as depicted above.

Prediction

I assume that SVO is the preferred word order in Chinese children and linguistic cues such as quantifier and aspect marker are useful to recognize the grammatical form of novel words. To examine which cue was more stable in cueing the referent of

the novel word, I made two cases where the word order and auxiliaries conflicted. If word order effect overrides aspect-marker effect, children in SVO-ambiguous condition perform similarly as in Verb position condition of Experiment 1 and the results of SOV-ambiguous condition and Ambiguous condition of Experiment 1 share a very similar pattern. These data would indicate that word order is stronger to recognize the novel word as a verb even it is attached with modifiers that usually appear with a noun.

Results

Same as previous analyses, I conducted a repeated-measure ANOVA with Condition (2: SVO-ambiguous, SOV-ambiguous) and Window (2: baseline, response) as within-subjects factors. This analysis revealed a Condition X Window interaction, $F(1, 10)=12.255$, $p<.05$, $\eta^2=.551$. The main effects for Condition and Window were both not significant.

To better understand the interaction effect, post-hoc analyses were conducted. Toddlers in SOV-ambiguous condition performed comparably in the baseline and response window (M=53, and .45, respectively), $t(11)=1.715$, $p=.114$. This shift in attention from baseline to the response window was evident in SVO-ambiguous condition (M=.36 and .56, respectively), $t(10)=-3.064$, $p<.05$. This suggests that infants shifted their attention from the novel scene to the familiar scene greatly when hearing the novel word in the verb position but with a noun modifier. In contrast, they maintained their interests in the novel scene when the novel word appearing after two nouns but followed by verb aspect-marker. It suggested that they failed to map the novel word to the actions. This provides evidence that word order overrides noun and verb auxiliaries in Chinese as cue for verb versus noun learning. And young children refused to use SOV order to build up the meaning of verbs.

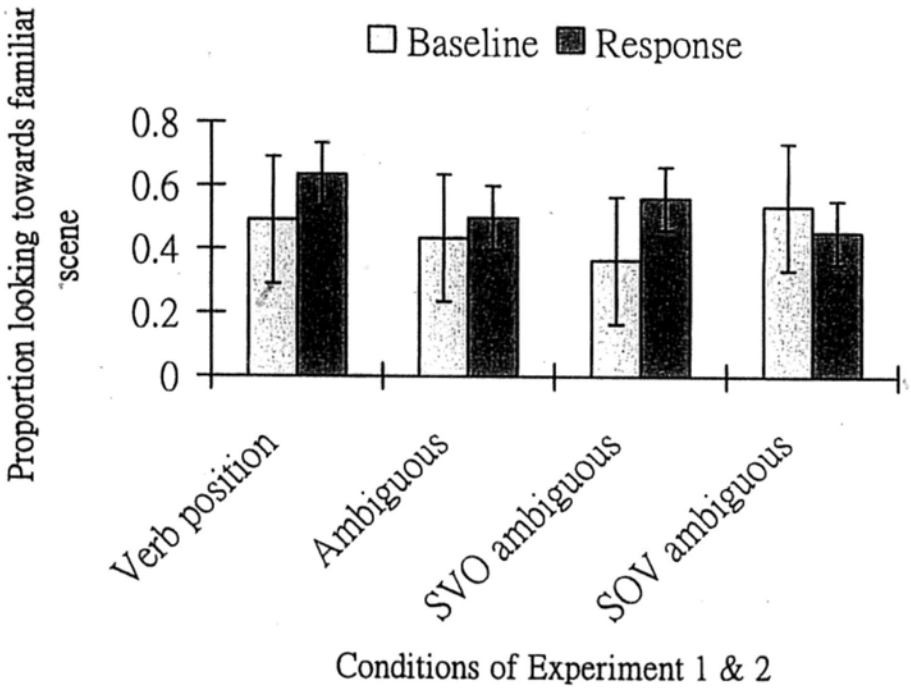

Fig.5. Study 3. Mean proportion of looking time towards the familiar test scene in the baseline and response windows, expressed as a function of audio condition

Discussion

Experiment 2 provided additional support for the importance of word order for young children's words learning. Even when the cues of modifiers were not consistent with the information conveyed by word order, children's performances still persist to reflect the SVO effect. It has to be emphasized that the conflict cases are natural in daily conversation in Chinese. Sometimes, the verb appears in the final position of a sentence after the subject and action participant. This SOV order exits at a small percentage in Chinese language however 2.5-year-old children not yet acquire this syntax and have strong tendency to stick to the SVO word order (Langus & Nespor, 2010). Even when the word between two known labels is modified by a quantifier which is normally applied to Chinese noun, children would judge it to be a verb.

General Discussion

In the present studies, I investigated the influence of the Chinese SVO word order on category accessibility for nouns and verbs. The results shed light on the important role of native-language syntax rules in the categorization and representation of information. The different positions of the novel word in a sentence would affect children's judgement of the meaning of this word. The results showed that when a novel word was placed in between two named nouns (the SVO order), the children interpreted it as referring to the action involved between the actor and the action recipient. However, when the novel word was placed at the end of the sentence after the two named nouns (similar to the SOV order), the children failed to link the word to the novel action which were possibly describing the relations between the subject and the action recipient. When the cues of linguistic modifies were contrasted with the cues of word order in deciding the word class, children's responses in mapping the novel word were consistent with those response in word order conditions. It indicates that word order is more important than modifies in children's understanding of the novel verbs.

How the child accomplishes the prevailing basic word order in the particular language community is the subject of some disagreement. Some theorists describe the acquisition of basic word order as the setting of 'parameters' that capture the systematic variation among the world's languages (Mazuka, 1996; Culicover, 1997). In this view, sample utterances act as 'triggers' for the setting of these parameters. Other theorists, however, place more emphasis on linguistic input and on the active role that children play in acquiring grammatical relations (O'Grady, 1997). According to these authors, children's acquisition of grammar involves a slow progress from general patterns to specific examples. So the major different between the two arguments involves the quantity of linguistic data required by the child to master the

basic word order of his/her language.

A recent study indicates that English-speaking two-year-olds do not have a truly general understanding of the SVO order (Akhtar & Tomasello, 1997). In this study, children were taught novel verbs for novel actions consisting of one toy character action on another in three sentence position: sentence-medial, sentence-final, and sentence-initial. Two-year-olds did use the non-SVO orders with novel verbs. In their produced sentences, the SOV structure was employed to indicate the action. And these results support the hypothesis that acquisition of a general understanding of the syntactic significance of word order is a gradual process. Younger children presumably do not have a fully understanding of the predominance SVO order in English (Akhtar & Tomasello, 1997). The analysis of the syntactic structures in the world's language suggests a syntactic preference for SVO (Langus & Nespor, 2010). However, the SOV order characterizes prelinguistic communication. Only in proficient language users the mapping between signal and meaning has to necessarily be mediated by syntax. Before they fully acquire the preferred syntax of SVO, the mapping between the signal and its meaning is achieved without the intervening syntactic computations responsible for phrase structure.

Cartwright & Brent (1997) provide evidence for a formal model in which children initially form syntactic 'templates' on the basis of the distributional analyses of linguistic input. According to this view, children do not have any general knowledge of syntactic categories until they have acquired enough similar templates from which they can abstract a general pattern. This reveals that children's understanding of syntactic structure is closely related to the statistical distribution of their input language. Their tendency to use SVO order to interpret the verb-object relations can be shown only when they have enough exposure of the language that follows this syntactic rule.

In current study, 2.5-year-olds readily appreciated and attended to word order; they were also able to respond appropriately in tests of acquiring the meaning of nouns and verbs via word order. Specifically, children displayed their sensitivity to the SVO order and responded differently to the non-SVO sentence structure. It seems to weaken the claims that young children lack a general understanding of the SVO syntax given that they rejected to use non-SVO order to interpret the novel label as a verb. To reconcile this discrepancy, we shall consider the experimental setting. Different from previous studies, a novel object was involved into the context. Though the novel object was not relevant to the action being performed, it was likely to be mentioned by the speaker. When the novel word appeared after the two know nouns, toddlers didn't shift their attention to the familiar scene which depicted the same action during naming. Their interests in the novel test scene when responding to the test question may imply that they didn't map the novel label to the action. However, I cannot draw conclusion that they attached the label to the novel still object because they could be attracted by a new different action performed on this object in the novel test scene. In experiment 2, when the label was modified by aspect-markers, young children still refused to use SOV order to assign the verb meaning to the word. It provided a strong accountable reason that children cannot use the SOV order to explain the situation.

Actually the current results are compatible with the theoretical perspectives that grant a more important role to the linguistic environment and to the learning capabilities of the young child. As even infants appear to be armed with powerful abilities to detect statistical regularities in the speech stream, they need more exposure in spoken language to learn different linguistic structures. The SOV order does not frequently occur in Chinese and thus children's experience with SOV sentences would not suffice to assist them making proper inferences about the meaning of a novel verb.

At an early age of two and a half years old, they cannot fully make use of the various patterns in linguistic input as only the SVO word order but not the modifiers affected their verb learning.

Study 4 Young children differentially weight social and linguistic cues in verb learning

A growing consensus among researchers in early verb acquisition is that children rely on multiple factors to learn and generalize new verbs. In a naming context, to discover how specific verbs encode event components, children may rely on information from the speaker. Such information includes linguistic data imparted in syntactic frames (e.g., syntactic bootstrapping; Fisher, 2002; Fisher, Hall, Rakowitz, & Gleitman, 1994; Gleitman, 1990; Gleitman & Gillette, 1995; Naigles, 1990, 1996) as well as social information conveyed by the extralinguistic context (e.g., comprehension of a speaker's attentional focus and communicative intent (Baldwin, 2000; Childers& Tomasello, 2002, 2006; Tomasello 1995; Tomasello, Strosberg, & Akhtar, 1996) and comprehension of actor intent (Behrend & Scofield, 2006; Poulin-Dubois & Forbes, 2002). Such cues in the social and linguistic context surrounding a verb constrain possible verb meanings.

The results from previous studies demonstrated that when a language offers minimal linguistic cues for identifying the form class membership of a novel word, children become sensitive to social cues in word learning. Although support exists for children's use of preferences based on the pragmatic context, research also suggests that these preferences are not sufficient. In order to successfully map an action onto a verb, children must rely on some combination of linguistic information and social intent. The present study aims to provide answers for the question that how young children coordinate these cues.

Different from previous studies, the goal of the present one is not to study the separate use of social and linguistic cues, which often, though not always occur in tandem as speaker information. In this study, the purpose was to tease apart the use of linguistic cues from social cues. I created a situation in which these cues either coincided or conflicted. In Coincident condition, the novel action occurred in the context was aligned with speaker information such that the novel word was presented with linguistic cues indicating it was a verb. In Conflict condition, the new element of the context was not aligned with speaker's information. For example, when a novel action was introduced the accompanied novel word appeared with noun markers.

Here I investigate young children's use of conflicting or coinciding social and linguistic information to determine how children discover the referent for a novel verb. The separate uses of social and linguistic cues were examined in the previous three studies and it shows that 2 year olds are capable of making use of the two cues separately to aid their verb learning. By pitting these cues against each other, the current research addresses whether young children differentially weight social and linguistic cues during verb learning. Since social cues in Study 1 didn't favor the noun learning, a special investigation on the issue would be focus on the verb learning in the present work.

Methods

Participants

Twenty-four 24-month-olds (20 boys) with a mean age of 24.22 months (range: 23.50-24.77, *SD*=.28) were included in the final sample. All were recruited from Hong Kong through the post on the internet of local child-rearing forum and were acquiring Cantonese as their native language. They were voluntary to come to participate and provided with reimbursement for their travel expenses. Infants were

mostly from middle-class families. Parents completed the Cantonese Communicative Development Inventory-Short Form Level II (CCDI; Tardif et al., 2008) which measured the early language development of words production in young children. Infants' mean production vocabulary was 87 out of 133 words (ranging from 26 to 133); there were no differences in vocabulary measures among the conditions. An additional 3 infants were excluded due to general fussiness and low language ability (CDI<5%).

Materials

Visual stimuli

This was identical to the videos in Study 1 (Appendix A). But only the Action-novel videos were used because the present study focuses on verb learning.

Auditory stimuli

The novel stimuli were two-syllable pseudo-words, the same as in Study 1. But the syntax that the novel word embedded varied as a function of audio condition. In Conflict (Noun) condition, children heard a native Cantonese-speaking female utters when watching the event, "**jat1 go3** (a) /bit1-dak1/ **hai6 dou6** (is)". In Consistent (Verb) condition, the word was presented as in "keoi5 **hai6 dou6** (is) /bit1- dak1/ **gan2** (-ing)".

Apparatus and procedure

Same as Studies 1 & 2.

Coding

The coding procedures were the same as in Study 1. Agreement between coders reached 90%.

Design & Predictions

In each test, there were both baseline and response windows. If infants are sensitive to the consistent events in the familiarization, they should detect the novel

element (either object or action) in the novel test scene, and should therefore reveal a strong preference for the novel test scene in the baseline window.

If toddlers weighted linguistic cues more than social cues, their performance in the response period should vary systematically as a function of the condition (Conflict and Consistent). If infants expect the novel words refer to the target action, then in response to the test question ("Where is /bit1-dak1/?"), they should search for the familiar event, directing their attention away from the novel test scene and toward the familiar test scene when the two scenes differed in the actions performed.

Table 7. Representative set of stimuli in the Action-novel tests of Study 4

Audio Condition	Familiarization (*3)	*Test*	
		Familiar Scene	*Novel Scene*
	Woman twirling umbrella on the shoulder, then spinning umbrella on the floor	Woman spinning umbrella on the floor	*Woman pound floor with the umbrella (only Action-Different)*
Consistent	"keoi5 hai6 dou6 (is) /bit1-dak1/ gan2 (-ing)"(he is bit dak ing)	*Baseline: "Look, they're different!"* *Test: "Where's /bit1-dak1/?"*	
Conflict	"jat1 go3 (a) /bit1-dak1/ hai6 dou6 (is)" (there is a bit dak)		

Results

To determine whether children perform differently as a result of audio condition, proportions of looking towards the familiar scene were entered into ANOVA with Condition (Conflict and Consistent) as between-subject variable and window (baseline and response) as a within-subject variable.

Table 8. The mean proportion looking at the familiar scene in Study 4 (N=10)

Audio condition	Baseline Mean (SD)	Response Mean (SD)
Consistent (Verb)	.36(.18)	.50(.11)
Conflict (Noun)	.46(.13)	.32(.17)

This analysis revealed an interaction effect for window by sound, $F(1, 18)=8.559$, $p<.01$, $\eta^2=.322$. The main effects for condition and window were found not significant. A planned comparison was conducted to better understand the interaction effect. I compared toddlers' performance between baseline and response window in separate Consistent and Conflict condition. Toddlers in Consistent condition shifted their attention from novel test scene (M=.36) to the familiar test scene (M=.49), $t(9)= -2.196$, p=.056. This suggested that they looked at the matched action scene more when the syntax of novel verb was consistent with the video in which the target action was added as a new element into the context. Toddlers in the Conflict condition didn't increased their attention to familiar scene from baseline (M=.46) to response window (M=.32), $t(9)=1.962$, p=.081. This suggested that infants did not match the familiar scene with the novel word when the information from video and audio were not consistent.

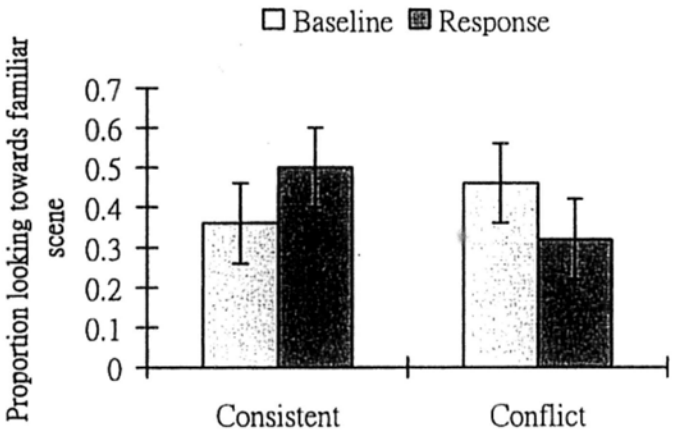

Fig.6. Study 4. Mean proportion of looking time towards the familiar test scene in the baseline and response windows, expressed as a function of audio condition

Discussion

The current research addressed whether young children differentially weight linguistic and social information during early verb-learning process. Linguistic cues were manipulated while pragmatic information was held constant. This design allowed us to reveal how children face the problem of referential ambiguity. The results demonstrated that 2-year-olds successfully acquired the meaning of a novel verb only when the linguistic marker was coherent with the pragmatic context. When presented with conflicting information, they failed. Young 2-year-olds could not override the linguistic cues of a noun in order to attach a label to the target action in the context. Although by 24-months, children are surely sensitive to social cues to a word's meaning, when faced with compelling linguistic cues, they were unable to rely on speaker information to solve the problem of verb mapping.

On the basis of these data, it is not claimed that 2-year-olds never attend to or are unable to use social cues to verb meaning. Rather, the data speak to the specific problem of learning a verb in the presence of competing linguistic information. Young children may only be guided by linguistic information when available. The social cues

itself cannot adequately account for children's learning of a new verb. The results reveal that young children rely much on speaker information from the syntax in their verb learning.

Previous findings strongly support the idea that 2-year-olds acquire novel verbs in joint attention contexts by being sensitive to the referential behavior of the speaker. Evidence from other studies also demonstrates an early reliance on social information for verb mapping and an emerging tendency to weight the syntax more heavily over developmental time. The present study cannot validate this proposed developmental change in reliance on the different cues since only one age group was included. But the result contributes to our understanding that information conveyed by syntax can be fully detected by 2-year-old Chinese toddlers. Syntactic cues seem to be more powerful in cuing toddlers' verb learning. Once children acquire the verb syntax, their learning processes are adult-like and not necessarily refer to the social information.

It seems that verb learning is different from noun learning with respect to the relative importance of social and linguistic cues. In order to acquire the meaning of a novel noun, children have to rely much on reading other's referential intent to identify the referent. However, it is not easy to use speaker's intent to make reference about the action that was mentioned by the speaker because verbs don't label enduring entities as nouns do. The objects that nouns label can generally stand alone while the actions that verbs label require some agent to perform them. When a novel action is performed on a novel object, it's hard to tell which one is the focus via reasoning about the speaker's internal thinking. And in real life, children may have more experience sharing attention with others on something instead of some fleeting movement. Usually the action captures children's attention through perceptual salience rather than other's attention. In conclusion, when the possible referents could be the action instead of the object, understanding of intent is less helpful to tackle the

verb mapping problem.

Chapter Three-Overall discussion

Word-learning is one of the major developmental achievements that lie at the intersection of language and cognition. It marks infants' entrance into a truly symbolic system. To succeed in word learning, infants must identify the relevant linguistic units, recognize their corresponding concepts, and establish a mapping between the label and the referents. My research concerned the process by which young children map words to concepts and establish reference. Do infants naturally assume that a word refers to an object, action, or event? How do they choose which object, action, or event should receive the label? It is proposed that young children begin the task of word-learning with a broad, universal expectation linking novel words to a broad range of possibilities. This initial expectation is subsequently fine-tuned on the basis of their experience with the communicative interactions and the native language under acquisition. In this chapter, the theoretical and empirical contributions of the present findings were discussed.

Different kinds of words may highlight different aspects of a single naming episode. I focused on specific noun-to-object and verb-to-action mappings in an ambiguous context in which a novel word is uttered and it either refers to the object or the action. The fours studies have tapped on four interesting research questions surrounding this topic. First, would 2-year-olds show evidence of word-to-world mapping when only social cues were available to suggest either a novel action or object should be the referent of a novel label? Second, would they use linguistic cues to mark nouns and verbs and establish the correct mappings? Third, would the position of the novel word relative to other constituents within a sentence be sufficient information for the toddler to decide on the grammatical class of the novel word?

Fourth, what would they learn when there were conflicting information provided by linguistic versus social cues?

The results suggest that toddlers are learning verbs with reference to the social cues. This result emerged in the test trials of Study 1. Toddlers linked novel labels with the actions that were introduced as a new element in the discourse context. Based on the results of Study 2, Study 3 and Study 4, it seems that linguistic cues are more powerful in helping toddlers identify the action as the referent for the novel word. Taken together, these four studies illuminate the contributions of different kinds of information to toddlers' early representation of novel verbs and nouns. 24-month-old toddlers were able to map novel verbs, and further, to extend them to scenes that differed from the ones they had seen during familiarization.

Verbs are no harder than nouns in Chinese word learning

When studying the early vocabulary of English-speaking children, their lexicons tend to be dominated by nouns and verbs that do not appear in appreciable numbers in infants' productive lexicons until 20-24 months. In the laboratory, novel nouns are learned and extended more quickly and easily than novel verbs in toddlers (e.g. Childers & Tomasello, 2002; Golinkoff, Hirsh-Pasek, Bailey & Wenger, 1992; Golinkoff, Jacquet, Hirsh-Pasek & Nandakumar, 1996). Even though verb-noun ratio is much larger in Chinese than in English, a similar result was found in learning the meaning for novel verbs in 3- and 5-year-old Chinese children (Imai, Haryu & Okada, 2005). It seems the two grammatical forms differ not only in the kinds of meanings they convey, but also their underlying course of acquisition.

However, the findings of my research have shown otherwise. Both Mandarin-speaking and Cantonese-speaking 2-year-olds demonstrated their learning of verb meanings in an ambiguous context by using both social and linguistic cues. In

the first experiment of Study 2, toddlers failed to map the novel word presented with an aspect-marker to the action and they mapped the bare word to the object instead of the action. Their performance indicated some general difficulty in learning the referent meaning of a verb. They refused to link the novel word without any cues to the action. One possible reason was that the test questions were asked in a noun-biased way. After I changed the specific wording of asking the test question from "which one is XX" to "where is XX", 2-year-olds overcame the difficulties and successfully attach the correct meaning to a novel verb. Combined the successful learning using social reference to aid verb learning, Chinese children do not show a difficulty in acquiring the meaning of verbs.

There are three streams of theoretical accounts for the predominance of nouns. First, Kersten and Smith (2002) and Echols and Marti (2004) suggest an attentional explanation: Children preferentially attend to objects and prefer to map new names to objects rather than to the actions in which the objects are engaged. Only when children know the name of the objects will they go on to learn the names of the actions. The present findings have not been supporting this account. In study 1, the children could attend to the action without knowing the names of the object involved as long as the appearance of the action went with the utterance of the novel label. Actually in Study 3, the action itself in the context was perceptually more attractive to the infants compared with the object receiving no action.

The second account is based on disparity in perception: While objects are often stable in time and space, actions are fleeting and dynamic and unfold in time and space. Extracting a categorical representation of actions (or the 'verbal essence'; Golinkoff, Chung, Hirsh-Pasek, Liu, Bertenthal, Brand, Maguire & Hennon, 2002) is more difficult than perceiving the object categories that nouns label (see also Golinkoff & Hirsh-Pasek, 2008). Learning the name of an action requires that

children perceptually abstract the invariants of the action (e.g. running) across multiple exemplars that show wide variation. For example, a toddler, Grandpa, and a dog all run, but do so in very different ways (Golinkoff et al., 2002). Study 2 provided some hint on the importance of multiple exemplars for verb learning. In the familiarization scenarios, four exemplars in which the exact action was performed on four objects of the same categories were demonstrated to the children. Hence it would be easier for children to isolate the action and understand the same label was used to refer the invariant action across those examples.

A third explanation of noun-verb disparity suggests that it is about the kinds of concepts than nouns and verbs label. The concepts represented by nouns are generally more imageable and easier to visualize as distinct separate entities than those represented by verbs. It is thus possible that what distinguishes nouns and verbs is not captured by the linguistic phenomenon of form class, but by a conceptual distinction between what these word classes tend to label. Perhaps the advantage nouns have is not a function of grammatical form class but rather is related to a word's imageability. McDonough, Song, and Hirsh-Pasek (2011) examined the relationship between imageability and age of acquisition, and the authors found a negative correlation between CDI age of acquisition and the words' imageability rating. A word's imageability contributes to the variance of the word's age of acquisition above and beyond form class, suggesting imageability as a driving factor at the beginning of word learning. Thus the different learning processes for nouns and verbs may not only be a function of form class, but also the conceptual nature of the word. Highly imageable words may be easier to learn because imageability relates to the saliency and consistency of contexts in which the word and referent pairing occurs. Words that name salient concepts (either objects or actions) may likely be easier to represent or imagine, and might thus be acquired earlier.

To overcome the difficulties of verb learning

To truly acquire the meaning of a verb, young children need to understand that the same verb can be applied to the same action performed by different agents on different objects. However, it has been reported that young children have difficulty in extending a novel verb based upon sameness of action, especially when the action is performed by a different agent (Kersten & Smith, 2002; Maguire et al., 2002) or with a different object (Behrend, 1990; Forbes & Farrar, 1993; Imai et al., 2005; Imai et al., 2008). Kersten and Smith (2002) introduced a novel verb for a scene in which a novel bug-like creature moved in a distinctive way, and found that 3-year-olds were not able to generalize this verb to the scene in which a different creature was moving in the same way. In contrast, children of the same age readily applied a novel noun introduced for the same scene to the same creature moving in a different way. Maguire et al. (2002) found that 18-month-olds who were introduced to a novel verb during a video of an intransitive action failed to generalize the verb to the same action performed by a new agent, even after they heard the verb repeatedly in association with the identical action performed by four different people. Other studies also showed that young children were reluctant to generalize a novel verb associated with novel transitive action to the same action performed with a different object (Behrend, 1990; Forbes & Farrar,1993; Imai et al., 2005; Imai et al., 2008).

In Imai et al. (2005), a novel verb were introduced to 3-year-olds in association with a novel action performed by a woman with a novel object. The children were not willing to extend the verb to another video showing the same object lying still on a table. Young children do understand that verbs should be extended by a different principle than for noun extension, but they have difficulty in identifying the core meaning of a novel verb, that is, the common relation between objects. Haryu et al. found that children's verb extension will be fostered if the objects involved are similar

(2011). However, this does not mean that young children do not know that verbs should be generalized by a different principle from nouns. In their study, 3-year-olds rejected an object as a referent of a novel verb. They do understand that verbs refer to relations between objects rather than objects per se.

In the present studies, the 2-year-olds could extend a novel verb to the same action when the objects involved were perceptually similar to each other, which was consistent with the findings from previous research. It suggests that object similarity plays a scaffolding role in verb learning. The results of the present studies provide an insight into the mechanism by which young children learn verb meanings. Initially, young children may be very conservative in generalizing verbs. They limit themselves to extending a novel verb to events that are massively similar to the event they originally experienced. Here object similarity can serve as a scaffold, by heightening the overall similarity across events in which the same action is performed. Once children have chosen the same-action event guided by overall similarity, this in turn provides them with an opportunity to compare the events in more detail and to extract the common action. Repeated experience of extending novel verbs supported by object similarity then bootstraps children to action-based verb extension without scaffolding from object similarity.

Given the variety of relations to which verbs can refer, it is not sufficient for children to understand that verbs refer to kinds of relations. Children also need to find out what kind of common relation should be preserved as a core meaning of a verb in the particular domain. In this regard, we should be cautious about concluding that children have abstract understanding of verb meanings even if they show some level of understanding. Even when children are able to extend a novel verb to the same action without scaffolding, they may still have a long way to go before achieving adult-like comprehension of verb meaning (Saji et al., 2008; Theakston, Lieven, Pine,

& Rowland, 2002). In any case, the results presented in the current research should not be taken to suggest that young children lack the ability to extend a novel verb (see Imai et al., 2005, for a similar discussion). Instead, they suggest that it takes children a long time to gain the robust, adult like representation of verb meanings that allows them to successfully extend a novel verb even when scaffolding is scant. Our research offers an account of how children go through this long developmental trajectory, and of how they build up expertise in verb learning that requires less and less scaffolding.

Domain-General vs. Domain-Specific Cognitive Processes for Verb Learning

There has been a long debate concerning the mechanisms by which young children learn verb meanings. Some argue that word learning is a product of all-purpose learning mechanisms like analogical reasoning (e.g., Gentner, 2006), associationism and generalization (Smith, 1999, 2000). Others argue for the importance of domain-specific knowledge of the mapping rules between argument structure and verb meanings (e.g., Fisher, Gleitman, & Gleitman, 1991; Gleitman, 1990) and also mindreading (Akhtar & Tomasello, 1996; Tomasello, 2003). The present findings seem to support a greater role of domain-specific knowledge in 2-year-olds word learning. According to the results, there are three possible ways guiding children's verb learning. They can use social information, grammatical cues and word position to distinguish verbs from nouns.

First, the results of the present research highlight importance of the domain-specific processes such as mindreading in word learning. Greenfield (1979, 1982) has argued that language is an effective communicative tool precisely because its users, including children, commonly share attention to certain things and notice the discourse newness in the context. By the end of the first year, infants develop a primitive theory of mind (Wellman & Phillips, 2001). They recognize people as

intentional agents. For example, they imitate other's incomplete, but intended actions (Meltzoff & Brooks, 2001), use social referencing to interpret their behavior, and treat adults as autonomous beings to be communicated through vocalizations. Once infants understand other beings as intentional, they can recognize the relevance of those intentions for learning words. For example, 24-month-olds can discriminate intentional action with accidental action and map a novel word uttered by the agent to the intentional one (Tomasello & Barton, 1994).

In the present research, toddlers used their understanding that speaker would call the name of a novel thing (either action or object) at the time it is new to the speaker. Before the naming, the toddlers saw the object played by the agent. When the target action appeared, it was performed on the same object. Thus the object was no longer prominent in the context since the newly appearing action easily captured the toddlers' attention. It would be easier to conceptualize the child's early cognition in terms of event structures with object being no more prominent in the child's conception of the world (Imai et al., 2008)

There might be two possible interpretations for these results. One is that the children learned the word for the novel action because their attention was automatically attracted to the new action at the same time they heard the novel word. This could be a simple association which made it unnecessary to credit two-year-olds with understanding the adult's referential intentions. However, results from the Novel-Object study in the present research excluded this possible explanation, because the infants failed to link the word to the target object which was a new element in the discourse context. An alternative account stipulates that children are indeed making active inferences about the adult's referential intentions using their knowledge of discourse pragmatics: People talk about things that are new and interesting. If they had wished to talk about the old element in the situation they

would have done so earlier.

Events may be represented in terms of causal relations or internal states (e.g., intentions, desires) which may not be directly observable in the events, but must be inferred from behavior. Tomasello (1995) suggests that lexical principles merely provide ad hoc explanatory frame work for the underlying processes responsible for early lexical acquisition. For Tomasello, the principle explanatory mechanisms of early verb learning lie in social, discourse and linguistic factors such as knowledge of word meaning combined with knowledge of the ongoing situation. Other researchers argue that by the time children reach two years of age, they have long since developed general cognitive learning principles to tackle lexical acquisition as well as other forms of mental representations (Bloom et al., 1993). Still others maintain that very young children exploit lexical information available in syntax such as whether an action is transitive, causative (Naigles & Kato, 1993), durative, or completive (Behrend, Harris & Cartwright, 1995) to aid their verb acquisition, representation, and extension (Gleitman, 1990).

Syntactic bootstrapping in Chinese verb learning

It is reasonable to assume that the type of language children regularly hear around them will influence their daily speech and eventually have impacts on their word learning processes. From the results of Studies 2 and 3, the importance of input language is highlighted. The world's languages draw on a common set of event components for their verb systems. Yet, these components are differentially distributed across languages.

How do children acquire these properties of language that marks word categories (e.g., "yat1gwo4 (one)" the classic modifier that marks nouns, "gan5" the aspect marker for verbs)? One possible way is by tracking available statistical information,

such as the frequencies and co-occurrence probabilities of sounds and words. Growing evidence suggests that infants are highly sensitive to statistical patterns in their auditory language input that mark word categories. For example, young children can reliably distinguish words from different syntactic categories by distributional properties, or the sentence contexts in which the words are likely to occur (Mintz, Newport, & Bever, 2002). It shows that experience with these cues facilitates the acquisition of semantic properties of word categories. Experience with statistical cues marking lexical categories sets the stage for learning the meanings of individual words and for generalizing meanings to new category members.

In my study, language-specific modifiers were used as effective cues for the grammatical distinction by 2-year-olds. It shows that children at this young age already begin to be sensitive to the function words in their language. The sentence context in which the words are likely to occur is also recruited in toddlers' word learning. As in Study 3, the particular linguistic context in which novel verbs were presented determined the toddlers' success in the task. Usually in a sentence, verbs appear between two noun phrases. If the novel word appeared after two noun phrases, the toddlers would fail to interpret it as a verb, because the semantic content inherent in the noun phrases labeling the verb's arguments (e.g., the balloon vs. it) helps toddlers discover verb meaning, over and above the benefits of informative syntactic contexts.

The present research findings on the effectiveness of linguistic cues were consistent with previous evidence that infants' experience with statistical cues relevant to segmenting words plays an important role in later word learning (Graf Estes et al., 2007). In the current research, I tested how experience with category-level grammatical cues helped toddlers to link individual words to specific meanings. In real life, children have accumulated abundant experience with classify modifiers

which always appear with a noun and aspect-marking that always follow a verb. So that these become useful cues that enabled infants to identify the referents of novel label. These findings are also consistent with the syntactic bootstrapping hypothesis (e.g., Landau & Gleitman, 1985). According to this theory, the process of learning word meanings is inextricably linked with syntactic knowledge. For example, the sentence contexts in which words occur provide important information about word meanings.

The present findings provide strong support for the hypothesis that infants begin to learn lexical categories from their experience with the sounds and distribution of words, even before they know words' meanings. They do not have to understanding the meaning of the modifiers because they can simply learn the rules by linking the distribution of the words to the lexical context. This initial exposure to distributional and phonological cues provides a foundation for acquiring a different source of information: the semantic properties of category members. It is becoming increasingly evident that infants' early experience listening to language profoundly affects their subsequent language development. Infants' experience with statistical regularities in their auditory environment allows them to detect and integrate new and qualitatively different information about such patterns, a process that appears to play a critical role in the acquisition of lexical categories (Lany & Saffran, 2010).

This finding also suggests that if there really is an object bias, it would be easily overridden by pragmatic information that contradicts it. This study simulates a very common situation in the lives of children at this age, which is hearing a new word just as some entity appears in the situation.

Specifying the role of linguistic information in verb learning

The current participants only succeeded at mapping and extending the novel

verbs when given linguistic information that was both semantically and syntactically rich. In Study 4, the toddlers tended to use linguistic information to explain the meaning of the novel word. Note that the difference of learning between Study 1 and 4 was whether a rich syntactic context was provided and it generated two different results. Thus it reveals the important role of linguistic information.

This is consistent with previous research in that syntactic frames are valuable for children to discover verb meaning. In a simulated word learning task, different kinds of linguistic information were provided for the guessing of what the word was uttered in silent video clips of naturalistic interactions between a parent and infant. The linguistic information consisted of a list of the nouns or the syntactic frames in which the verb appeared. Participants hearing the list of nouns guessed the verbs 29% of the time while those hearing syntactic frame performed significantly better, with 53% correct guessing of the verbs. Evidence from 3- and 7-year-olds in the similar simulated word guessing tasks also suggested that linguistic information is important for guessing verbs. It seems that the two types of linguistic information-syntactic frame and semantic context of argument labels- are valuable for adults and older children to discover verb meaning (Arunachalam & Waxman, 2010).

Limitations and Future directions

It is better to recruit data from different age groups for a comprehensive understanding of how toddlers develop to use different cues in their nouns and verbs learning. The factors that influence mapping seem to undergo developmental changes. At the first stage, verb learning is first governed by perceptual factors, with interesting events preferred as verb referents. However when they encounter more ambiguous situation in which the perceptual cues are not consistent, additional scaffolds in the form of social and linguistic information are required. Why children shift in their use

of these cues and how they develop to use different cues are projects for further research.

The sample size was rather small. The individual differences in looking and video learning are large. Without an adequate number of participants, the conclusions are hard to be representatively generalized to children at the same age. It would be interesting to examine whether there are individual differences in verb learning that are predictive of later language development. Children's expressive vocabulary may be a better predictor of early verb generalization. Evidence from other studies has shown that high vocabulary children know that different actors performing the same action can be labeled by the same verb. They extend familiar verbs based on their knowledge of verb meaning rather than solely on the appearance of specific actions and individual outcomes.

In addition, there was also a problem about the selection of the response time. Recall that each infant in the current experiments participated in 10 different trials, each featuring its own particular novel word and scenes, but each conforming to the very same design structure. These design features raised an intriguing possibility that the infants' responses may become more rapid over the course of the trials. Other study using the same experimental design proved that infants respond more rapidly on later than on earlier trials (Waxman et al., 2009).

This research has particular implications for the role of oral language ability in children's later reading achievement. As Snowling et al. (2000) argued, oral language skills, such as semantic and syntactic skills, make an important contribution to literacy development. The performance of young children in lexical acquisition reflects their ability to master the meaning of new words and especially how they use their syntactic knowledge to aid their word learning. Hence, individual differences in performance of word learning are related to later reading development. On the other

side, the chief barrier to comprehension of early readers is deficiency in mapping the relationship between the alphabetic or orthographic representation of words and their spoken counterparts (Shankweiler et al., 1999). In the task of word learning, the acquisition of a new word relies on the mapping ability that links sound stimulus to the referent in reality. The underlying mechanism accounted by associative learning could be the same for both word learning and reading, which awaits further research examination.

Conclusion

In this research, I addressed the question of what factors facilitate verb meaning acquisition in Cantonese-speaking children. The results suggest that 2-year-olds are able to use social cues and syntactic information to identify the referents of novel words. Syntactic cues may also override social cues in verb learning at around 2 years of age. This research highlights the importance of syntax in Chinese verb learning.

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Appendix A. Complete set of stimuli for Study 1

Novel word	Familiarization	Familiar test scene	Novel test scene	
			Action-Different test	Object-Different test
Novel-Object				
/bit1-dak1/	Waving lollipop →fan	Waving fan	Clapping on fan	Waving balloon
/ke4-lai4/	Throwing shuttlecock→ bottle	Throwing bottle	Tapping bottle	Throwing ball
/sou1-gwai1/	Zipping hand bag→jacket	Zipping jacket	Put on jacket	Zipping clutch
/ngaam4-gwai1/	Carry on shoulder doll→ pillow	Carry pillow on shoulder	Carry pillow under arms	Carry hand bag on shoulder
/mok6-fai1/	Shaking corn→ box	Shaking box	Open the box	Shaking mobile phone
Novel-Action				
/taam1-gok3/	Swirling umbrella→ Spining umbrella	Spining umbrella	Knocking the floor with the umbrella	Spinning besom
/faan1-gat1/	Lift cup →wash cup	Wash cup	Turn over the cup	Wash dish
/gwaan1-kat1/	Sit down on the chair →pulling chair	Pulling chair	Lift up the chair	Pulling case
/saai3-jau1/	Spinning book with a finger → turning page of the book	Turning page of the book	Under score on the book page	Turning page of a standing calendar
/peng4-ziu1/	Shaking doll → Wiping with the doll	Wiping with the doll	Caress the doll	Wiping with a triangle cardboard

Appendix B. Complete set of stimuli for Study 2 & 4

Novel word	Familiarization	Familiar test scene	Novel test scene	
			Action-Different test	Object-Different test
/bit1-dak1/	Waving balloon	The same as in familiarization	Clapping on balloon	Waving fan
/ke4-lai4/	Washing cup		Drinking from cup	Washing dish
/sou1-gwai1/	Pulling chair		Lift chair	Pulling box
/ngaam4-gwai1/	Twirling umbrella		Spinning umbrella	Twirling broom
/mok6-fai1/	Carrying bag		Holding bag	Carrying bunny
/taam1-gok3/	Turning over pages		Rotate the book	Turning over desk calendar
/faan1-gat1/	Shaking box		Open box	Shaking a corn
/gwaan1-kat1/	Wiping with doll		Rolling doll	Wiping a stapler
/saai3-jau1/	Zipping up bag		Swaying bag	Zipping up clothes
/peng4-ziu1/	Throwing bottle		Knocking with bottle	Throwing shuttlecock

Appendix C. Complete set of stimuli for Study 3

Novel word	Familiarization		Test	
	Novel object	Novel action	Familiar test scene	Novel test scene
/de2-bi3/	bottle	Waving mobile phone	Waving mobile phone	Knocking with bottle
/mu4-hui1/	stand of CD	Flying toy plane	Flying toy plane	Spinning stand of CD
/su4-gui1/	headphone	Folding tissue	Folding tissue	Pulling headphone
/zhang1-pin3/	shuttlecock	Moving bus	Moving bus	Throwing shuttlecock
/fan1-ji2/	stick	Jumping duck	Jumping duck	Massage with the stick
/zhi4-yan2/	stapler	Shaking doll	Shaking doll	Pressing stapler
/guan1-qing1/	stick band base	Fling spoon	Fling spoon	Pushing stick band base
/shai4-you1/	triangle cardboard	Chopping apple	Chopping apple	Wiping with triangle cardboard
/jiao3-tan1/	frame	Tickling banana	Tickling banana	Swinging frame
/li3-qie2 /	folder	Smelling bread	Smelling bread	Flapping folder