Children's use of argument structure, meta-knowledge of the lexicon, and extra-linguistic contextual cues in inferring meanings of novel verbs

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- Young children learn many words everyday.
- Word Meanings are not taught, but are learned by inductive inference

Why inductive inference?

- Because children only witness a word being used in one situation.
- From there, children need to infer what the referent of the word would be, and what other things (or events) the word can be also applied.
- Too many possibilities arise from a single instance of the word use. Hence inference must be constrained

Big Question

- How do young children constrain possible word meanings?
- Structural information constrains possible meanings of words (Quine, 1969; Gleitman et al., 1990)

Goals of the talk

- Discuss how young children utilize structural information in inferring meanings of new words
  - What other sources of information do they use to constrain possible word meanings?
  - How strongly do children rely on structural information in this process compared to other sources of constraints?

Organization of the talk

- How children map and generalize novel nouns and verbs onto a action event
- Use of sound symbolism (non-structural cue) in novel verb learning
- How children utilize structural cues (argument structure) in inferring novel verb meanings and how it interacts with linguistic properties of the native language

Part 1

- How young children learning Japanese, Chinese, or English map novel nouns and verbs onto dynamic action events

To learn a new noun or a new verb

- Children must know what aspect of the action event the *word* is mapped onto, and how it is generalized to new instances.

Specifically

- Map the word to the referent
  - Finding the form class of the word
  - Knowing the form-meaning mapping rule
  - Applying the mapping rule
- Generalize the word to the new instance
  - Different generalization principle is applied to different form class words

Mapping and Generalizing Nouns and Verbs

- NOUNS:
  - Map to an OBJECT in the action event
  - Generalized on the basis of the sameness of the OBJECT, where the action using the object is irrelevant
- VERBS:
  - Map on the ACTION in the action event
  - Generalized on the basis of the sameness of the ACTION, where the object involved in the action is a variable

Research Questions

- How early do children know the form class-meaning mapping and generalization rules for nouns and verbs?
- Do young children learn novel nouns and verbs equally well?
- Do linguistic properties of children's native language affect novel noun and verb learning?

Noun vs. Verb Controversy

- **Universal noun-advantage view**
  Nouns are learned earlier and faster than verbs because concepts denoted by nouns are usually perceptually salient and stable over time, while concepts denoted by verbs are ephemeral. (Gentner, 1982)
- **Input-dependent view**
  Early noun learning advantage is not universal. If verbs are salient and dominant in the input language, verbs are learned earlier than nouns. (Gopnik & Choi, 1990; Tardif, 1996)

  ⇒Korean, Japanese, Chinese…

Properties of language that may affect verb learning

- Argument dropping
- Simplicity of Verb Morphology

Argument dropping

- Pros
  - Perceptual saliency of the verb
  - High verb frequency compared to noun freq.
- Cons
  - Cues from structural information often not available

Simplicity of Verb Morphology

- Pros: Children do not need to remember different verb forms
- Cons: Verb is not easily distinguishable from other word class in the sentence

Properties of Japanese and Chinese Languages

	English	Japanese	Chinese
Argument Dropping	No	Yes	Yes
Inflectional Morphology	Yes	Yes	NO

Questions

- Do Japanese and Chinese children learn novel verbs more easily than novel nouns?
  - If only verb frequency matters Chinese=Japanese>English?
- Does the presence of verbal morphology influence children's verb learning?
  - If morphological simplicity makes verb learning easier, Chinese > Japanese=English
- Taken the two factors together:

Chinese > Japanese >English

Crosslinguistic comparison of novel noun and verb learning(Imai et al., 2008, *Child Development*)

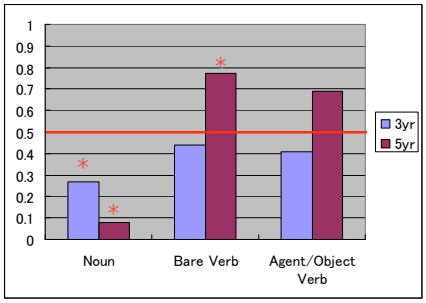
- Language: English, Japanese, Chinese
- Condition: Noun
  Verb with Arguments
  Bare Verb
  (Bare Word for Chinese)
- Age groups: three- and five-year-olds

- Noun condition “Look, there is (an) X.”
- Verb with Arguments “Look, she is X-ing something.“
- Bare Verb “ Look, X-ing” (Eng and Jap)
- Bare Word (Chinese) “Look, X!”

Test

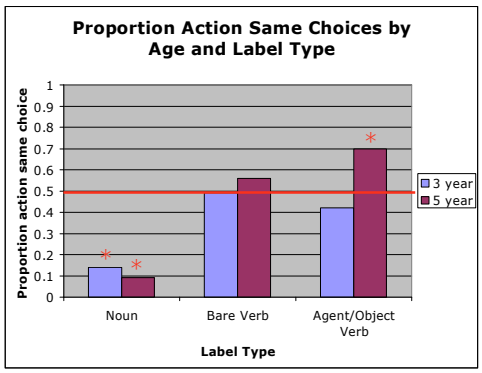

Noun condition “In which movie is there (an) X ? “
Verb with Arguments condition
“ Where is she X-ing it?“
Bare Verb condition “Where is X-ing ?”

Japanese results

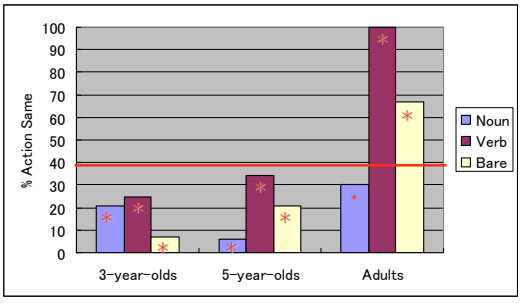


Proportion of Action-Same Choice

English Results



Chinese Results



Proportion of Action-Same Choice

Results Summary of the crosslinguistic study

- In all three languages, children were more successful in mapping and extending novel nouns than novel verbs.
- English and Japanese 5-year-olds succeeded in novel verb learning only when verbs were presented in the familiar structural form in their input.

→Language specificity seems to matter for verb learning but not so much for that of nouns.

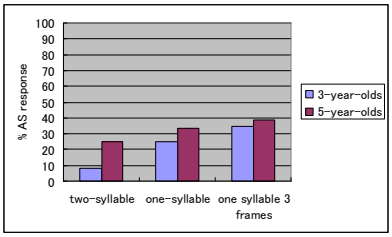
Results Summary Continuted

- Chinese preschoolers mapped novel words to the Object-Same event regardless of the word form.
- Chinese children seem to be more Noun Biased than English and Japanese children.

Why do Chinese children have so much difficulty?

- To identify the grammatical class of each word in the sentence, Chinese speakers have to coordinate semantic, syntactic, semi-morphological grammatical cues in "a complex system of mutual constraints" (Li et al., 1993). For children, sophisticated linguistic knowledge may be required to identify a verb and its argument structure in the sentence in Chinese.
- Chinese has a large number of words that can be used as nouns and verbs.

Does extra linguistic cues help Chinese children?



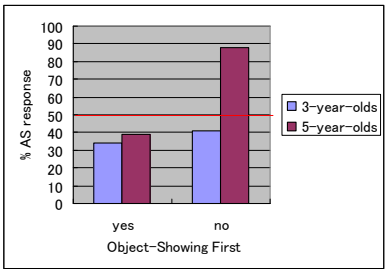
Use of Extra-linguistic cues in Chinese children

- Sophisticated linguistic knowledge may be required for Chinese children to identify verbs and their argument structures.
- This may lead Chinese children to rely more on extra-linguistic cues in verb learning

Deemphasizing the action made a drastic difference

original

First part clipped



- But Chinese 3- and 5-year-olds still mapped novel nouns and class-ambiguous words (Bare Word) to the object with the edited video.

Conclusion

- **Children are universally biased toward naming novel objects**
- **Morphological similarity impedes verb learning**
  →It is important that verbs are clearly distinguished from nouns in the word form

Question

- Are there ways to facilitate young children's verb learning?
  - Linguistic cues did not help Chinese children much
  - Extra-linguistic cue (manipulation of the video) helped Chinese children's verb learning greatly

Part 2: Sound Symbolism Bootstraps Verb Learning

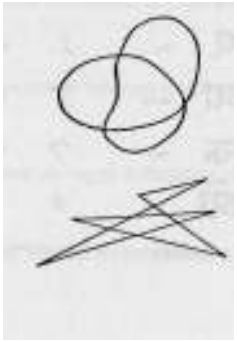
Sound-Meaning connection in traditional linguistics

- The sound-meaning link is arbitrary
  - The connection between the signifiant and sinifie is arbitrary, or since we understand the total sign resulting from the association between the two, we can simply say: The linguistic sign is arbitrary. (Saussure, 1979:100)

    sakana → fish

    takana →Japanese vegetable

Sound Symbolism



Which is "maluma"?
Which is "takate?"

(Kohler, 1947)

Mimetic Words

- Vision
  - maru maru (chubby)
  - pika pika (twinkling)
- Touch
  - sara sara (smooth)
  - beta beta (sticky)
  - fuwa fuwa (fluffy)
- Body Movement
  - pyon pyon (hopping)
  - kuru kuru (spinning)
  - koro koro (light object rolling)
  - goro goro (heavy object rolling)

Mimetic words (as a distinct word class) are identified world-wide

- most sub-Saharan African languages (called "ideophones)
- many of the South East Asian languages (called "expressives)
- many East Asian languages
- Australian Aboriginal languages
- Indigenous languages in South America
- Basque, Finish and Estonian

Japanese children love onomatopoeia and mimetic words

- Children's books contain more onomatopoeia and mimetic words than any other genre (Oda, 2000)
- Fernald & Morikawa (1993)
  - Japanese mothers frequently used onomatopoeic labels when referring to objects (e.g., *buubuu* for 'car'; *wanwan* for 'dog')

Sound symbolism bootstrapping hypothesis

- Sound symbolism helps children learn words, especially verbs (action verbs)

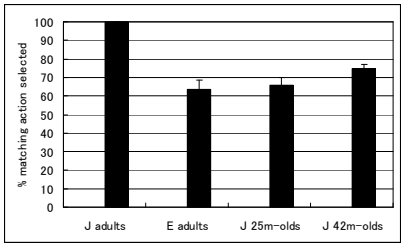
Test of the sound symbolism bootstrapping hypothesis (Imai et al., to appear, *Cognition*)

- Novel mimetic verbs should be better learned than novel verbs that do not have sound symbolic properties.

Can young Japanese children and non-Japanese adults match a novel mimetics to the "correct" action?


- Select the matching novel mimetic verb
- Nosunosu-shiteiru no wa docchi？
  (Where is (it) doing nosu-nosu?)

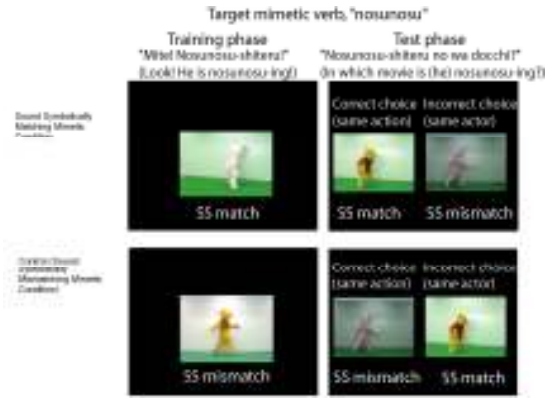
Results of the action-mimetic words matching study



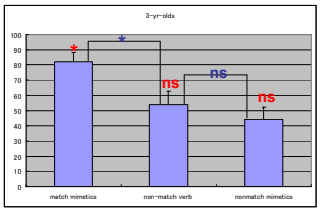
Significantly above chance in all groups

Novel verb generalization

- Participants: Japanese 3-year-olds (16 children in each age/condition)
- Conditions:
  - Novel mimetic verb condition (Novel mimetic verb matching to the target action)
  - Novel verb (non-sound symbolic) condition
  - Control (Novel mimetic verb non-matching to the target action and matching to the distractor)

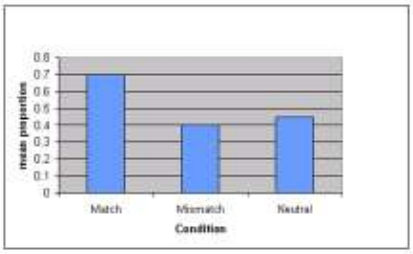


Results of Study 2 (verb generalization)



- Sound symbolism bootstrapping effect found

How about English-speaking children?



Discussion

- Some elements of sound symbolism in Japanese mimetics can be detected by very young children and even by non-speakers of Japanese.
- Children are (universally) able to utilize sound-meaning correspondence as a cue to infer novel verb meanings

Part 3: Use of case marking and number of arguments in novel verb learning

Backgrounds

- Structural information provides important constraints for word learning.
  - To identify Word Class (Noun, Verb, Adjectives) and apply the word class-meaning linking rules
- Structural information is particularly important for identifying sub-types of verbs
  - Verbs referring to caused actions and verbs referring to non-caused actions

- What structural cues do young children use? (e.g., Slobin & Bever, 1982;MacWhinney & Bates, 1989, Fisher, 1996; Fisher & Song,2006)
  - Word Order
  - Case Marking
  - Number of Arguments

Number of Arguments Constraints Hypothesis

- Children first rely on number of arguments over case marking for determining whether a novel verb refers to a caused motion or non-caused motion (Litz, 2006)
- One argument⇒non-caused motion
- Two arguments⇒caused motion

Argument-dropping languages

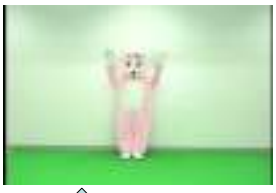
- The Subject and/or the object of the sentence is frequently dropped.
- Children often hear sentences with a single argument

Problem of single-argument sentences in argument dropping language

- Subject-only-single-argument sentences are ambiguous with respect to Spontaneous vs. Caused motion reading
- Object-only sentences are not ambiguous , but are in conflict with the argument-number hypothesis

When the number of arguments is one in Japanese

- Subject-only sentence (with the Nominal marking) is ambiguous
  - Usagi ga X-teiru
    rabbit NOM X-ing
    Both possible: Usagi ga X-teiru
    Usagi ga Y o X-teiru (Y dropped)
  - Object-only sentence (with the Accusative marking) is not ambiguous
  - Usagi o X-teiru
    rabbit ACC X-ing
    Always: Y (Subject) ga Usagi o X-teiru




Both possible

Usagi (rabbit) ga (NOM) X-teiru


Only this

Usagi (rabbit) o (ACC) X-teiru

Questions

- How do Japanese children map a sentence with one (surface) argument?
  - Do they rely on Argument Number even though it is not reliable?
  - Are children aware of ambiguity in the subject-only sentence? From the beginning?
  - Can they map the object-only sentence? From the beginning?

Prediction

- **If the Argument Number constraint hypothesis holds, Japanese children would map a verb in both the subject-only and object-only sentences to a spontaneous action.**

Sentence-video mapping Studies

- Study 1:
  - N: Nominal marked: Ambiguous
  - Video 1: N→Agent of non-caused motion
  - Video 2:N →Agent of caused motion
- Study 2:
  - N: Accusative marked: Unambiguous
  - Video 1: N →Agent of non-caused motion
  - Video 2: N →Patient of caused motion

Study 1: Subject only Ambiguous

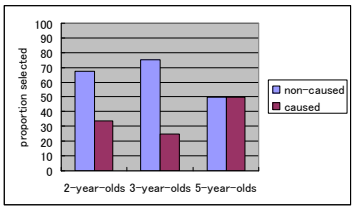
- Participants: monolingual Japanese children
  - 16 2-year-olds,18 3-year-olds,15 5-year-olds

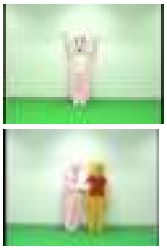

Usagi ga X-teiru no wa docchi

Rabbit NOM X-ing Gerund Topic Which

In which movie the rabbit is X-ing?

Subject Only Ambiguous





2, 3-year-olds: Go with Argument Number

5-year-olds: Become aware of the ambiguity in the Subject Only sentence

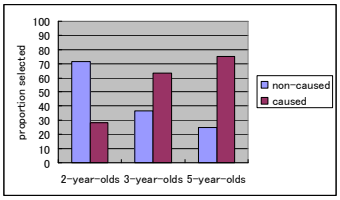
Study 2: Object only unambiguous

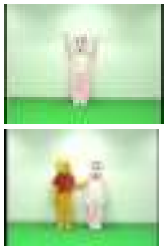
Participants: monolingual Japanese children

15 2-yer-olds, 17 3-year-olds, 14 3-year-olds

Usagi o X-teiru no wa docchi
(In which movie (Subj-omit) X-ing the rabbit?)

Object Only unambiguous





2-year-olds: Mapped Object only sentence (transitive sentence with the subject dropped) to non-caused motion according to the number of argument

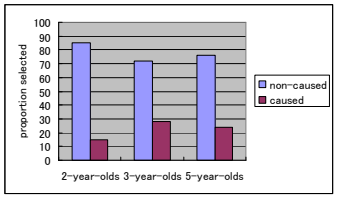
Study 3: Subject only unambiguous (Control)

Participants: monolingual Japanese children

10 2-year-olds, 15 3-year-olds, 20 5-year-olds

Usagi ga X-teiru no wa docchi
(In which movie the rabbit is X-ing?)

Subject-only Unambiguous



When there was only one event in which the subject had the Agent role, older children could map the Subject-only sentence to the non-caused motion.

Their chance-level performance in Study 1 could not be due to a lack of understanding of the intransitive-non-caused action mapping.

What about German children?

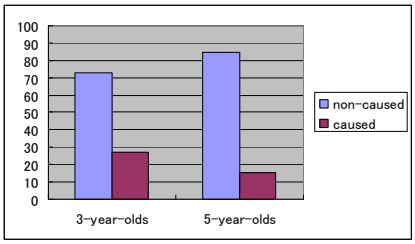
- Argument dropping does not occur frequently in German
- Do German children find the Subject-Only single argument sentence ambiguous as Japanese 3- and 5-year-olds do?

Study 4: Subject only Ambiguous (Study 1) with German children

- Participants: monolingual German children
  - 12 3-year-olds,16 5-year-olds


Zeige mir das richtige Bild! Der Hase X.

Show me the right picture! The rabbit X



Unlike Japanese age-mates, German 3- and 5-year-olds had no problem in mapping the Subject-Only single argument sentence to the non-caused event.

Discussion

- **Children seem to start out with a simple assumption that a sentence with a single argument maps to non-caused event.**
- **But if they are learning an argument-dropping language, they soon become aware of ambiguity of Subject-only sentences.**
- **Mapping a object-only sentence to a caused motion is cognitively more demanding and hence difficult for 2- and 3-year-olds.**

- Children do understand basic syntax-meaning mapping rules.
- But they become aware of the limitation of the mapping rule when the language allows ambiguity in mapping.

- Do children apply the argument-structure – meaning linking rules when there were two participants?
  - X and Y are VERB-ing
    ⇒Non-Caused Motion?
  - X is VERB-ing Y
    ⇒Caused Motion

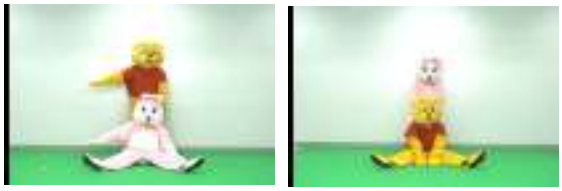
Use of Analogy from Words in the Vocabulary

- Verbs in Single Argument (Intransitive) and Two Arguments (Transitive) sentences with two participants
  - X and Y are VERB-ing
    ⇒Non-Caused Motion?
  - X is VERB-ing Y
    ⇒Caused Motion

One argument sentence with two participants

- X and Y are VERB-ing
  - playing, exercising, fighting
- In these events, X and Y do not always have to be moving in synchrony
- X can be pushing Y and they can be playing together

How do young children map a intransitive and transitive sentences?

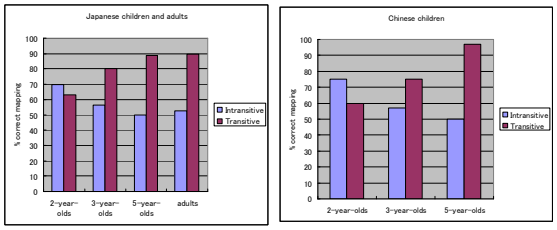


Intransitive: Look, the rabbit and the bear are X-ing

Transitive: Look, the rabbit are X-ing the bear

- Japanese
  - INTR: Mite, kuma-san to usagi-san ga X te-iruyo
    bear AND rabbit NOM VERB-progressive
  - TRAN: Mite, kuma-san ga usagi-san wo X-te-iruyo
    NOM ACC
- Chinese
  - INTRA:兔子 和 熊 正在 X
    rabbit AND bear right now VERB
  - TRAN:兔子 正在 X 熊
    rabbit right now VERB bear

Results from Japanese and Chinese children



Correct Mapping: Intransitive ⇒Spontaneous motion

Transitive ⇒ Caused motion

- Intransitive: In both Japanese and Chinese groups, 2-and 3-year-olds follow the canonical intransitive-non-caused mapping rule, but at 5, their performance become random.
- Transitive: In both groups, children are able to apply the transitive-caused mapping rule, and their performance become more accurate with age.

- Children first follow the linking rule, but with the expansion of the vocabulary size, they become aware of the ambiguity in intransitive sentences involving two participants.

General Discussion

- In general, verb learning is a challenge for young children across different languages.
- Children utilize different cues to constrain possible verb meanings
  - Structural cues (argument structure, morphology)
  - Meta-knowledge about the lexicon
  - Contextual cues
  - Sound symbolism
- Weights children place on different cues change through development

In what degree does structural information useful for word learning?

- It is useful
- But it is not the only source of constraints children use
- Not is it the one children rely on most strongly

- Children build up meta-knowledge about the lexicon through the interaction between their inherit cognitive/perceptual disposition and word learning experiences in their native language
- In general, cognitive (semantic) factors and extra-linguistic factors seem to play more powerful role than structural cues but the degree in which children rely on structural cues depends on language-specific distributional and structural properties of the specific language children are learning.