Sound Symbolism and the Symbol Grounding Problem: How sound symbolism can be iconic and language-specific

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Goals of my talk today

- Establish that
  - Most word-meaning correspondences are language-specific
  - Investigation of sound symbolism provides deep insights onto the Symbol Grounding Problem.
- Discuss
  - How language-specific sound symbolism arises
  - how children are immersed into language-specific sound symbolism
  - Implications for the Symbol Grounding Problem

The Symbol Grounding Problem (SGP)

- The Chinese Room Problem (Searle, 1980; Harnad, 1990)
  - Giving a definition of a unknown word using another unknown word does not help learners

  Q: What is “wabi”?

  A: It’s like “sabi”
- **Symbols cannot acquire meanings through transformations of other symbols.**
- **To avoid the symbol-to-symbol Merry-Go-Round, symbols must be connected to the world, especially to the body (Harnad, 1990).**

Embodiment and Iconicity

- Symbols can acquire meanings only through embodiment. (e.g., Barsalou, 1999)
- Symbols are multi-modal.
- Iconicity, but no arbitrariness, is a design feature of language (Vigliocco, Perniss & Vinson, 2014).

Iconicity plays a key role in

- Language evolution
  - Our ancestors started language using bodily gesture as symbols, which turned into oral gesture (e.g. Arbib, 2005; Ramachandran & Hubbard, 2001)

- Language development
  - Sound symbolism bootstrapping hypothesis (Imai & Kita, 2014)

What is embodiment?
What is iconicity?

- Is iconicity necessarily universal and direct?
- **Are all words in the lexicon iconic and perceptually based? (cf. Barsalou, 1999)**
  ⇒NO
- **Seemingly most "perceptual" words (e.g., "red" or "walk") are very abstract when thinking about the range of things they can refer to.**

If the meanings of words are abstract, then

- How do children break into language, which is a system of abstract symbols?
- How do children acquire abstract meanings of words without falling into the symbol to symbol Merry-Go-Around (cf. Harnad, 1990)?

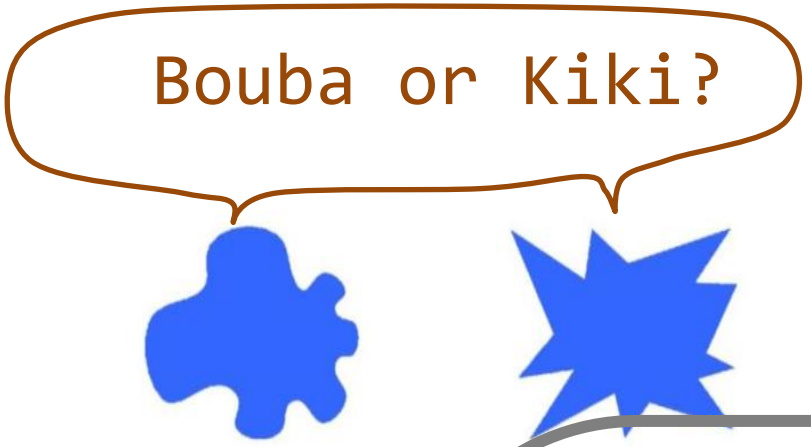
⇒The Symbol Grounding Problem should address both questions

The Sound Symbolism Bootstrapping Hypothesis (Imai & Kita, 2014)

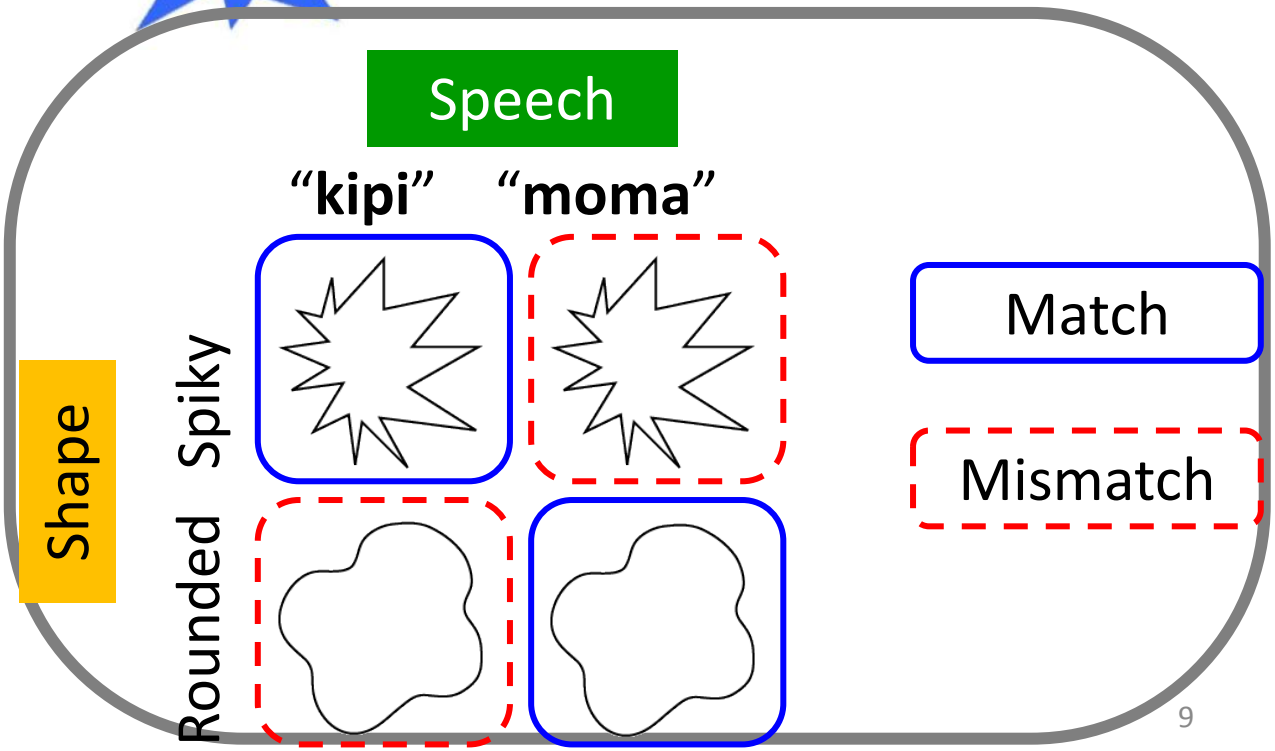
1. Sound symbolism helps infants gain referential insight for speech sounds (Asano et al., 2014, *Cortex*)
2. Sound symbolism helps infants and toddlers associate speech sounds and referents (Imai et al., 2015, *PLoS ONE*)
3. Sound symbolism helps toddlers and preschoolers find the basis for generalization (Imai et al., 2008, *Cognition*)

The Bouba-Kiki effect

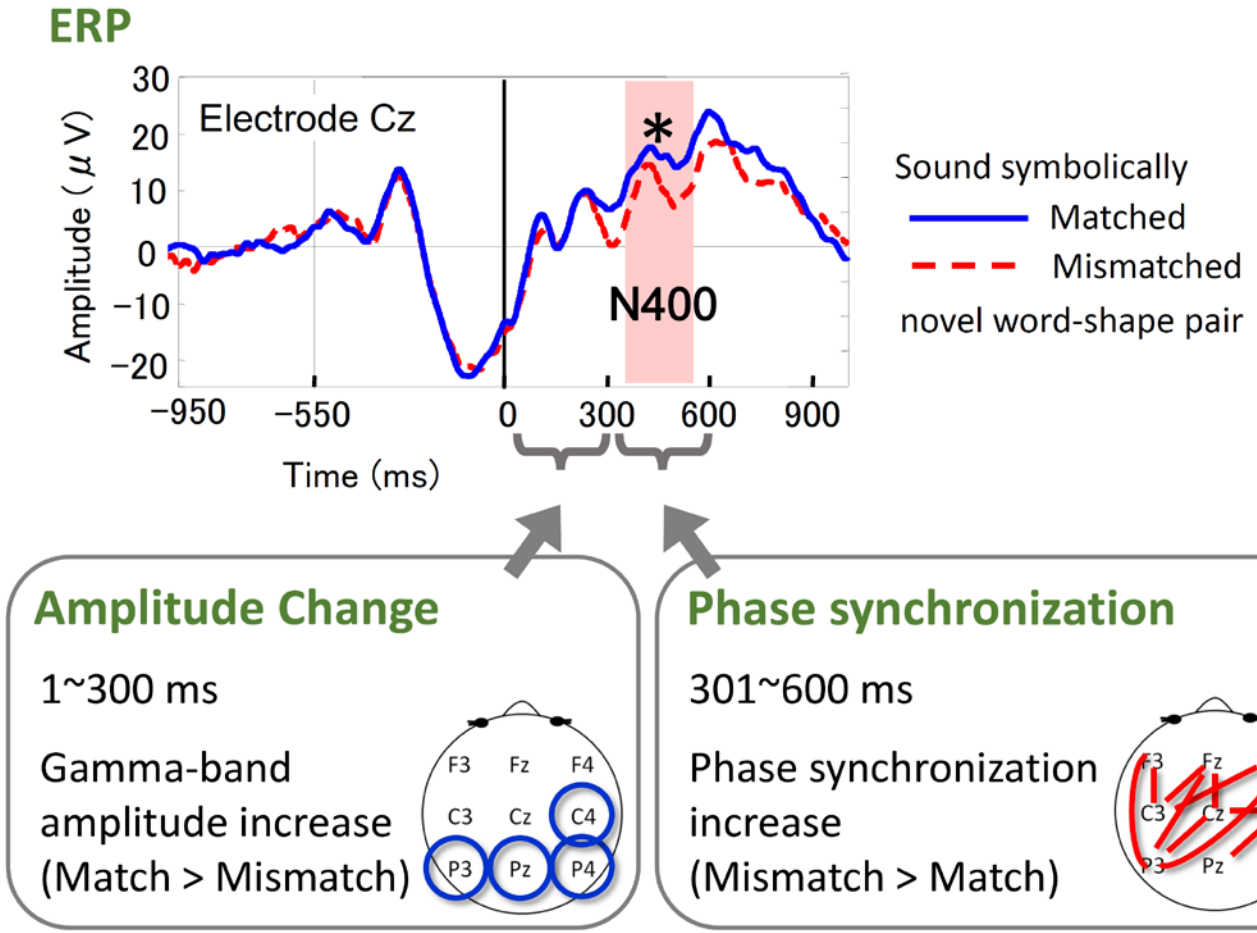
(*Köhler, 1929;* Ramachandran & Hubbard, 2001)



11 month-olds tested on EEG

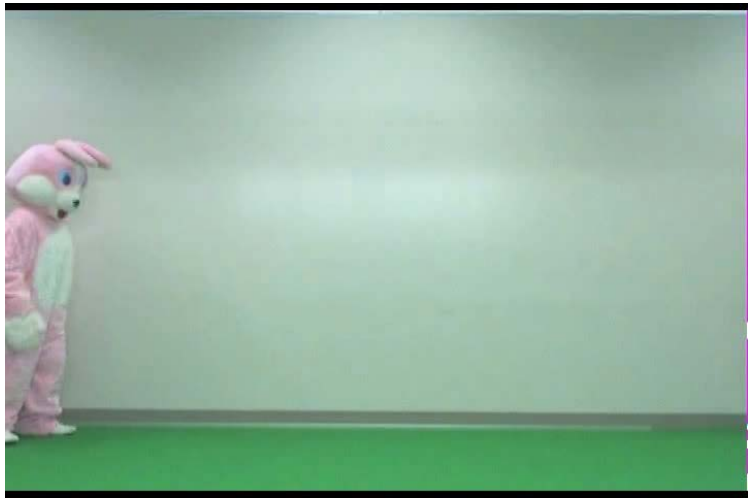


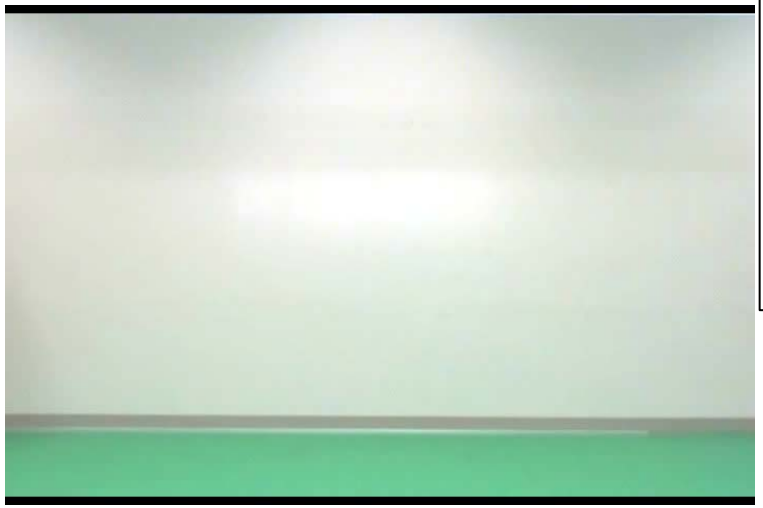
11 month-olds' brain treated a mismatching novel sound-shape combination as if the shape received a wrong label

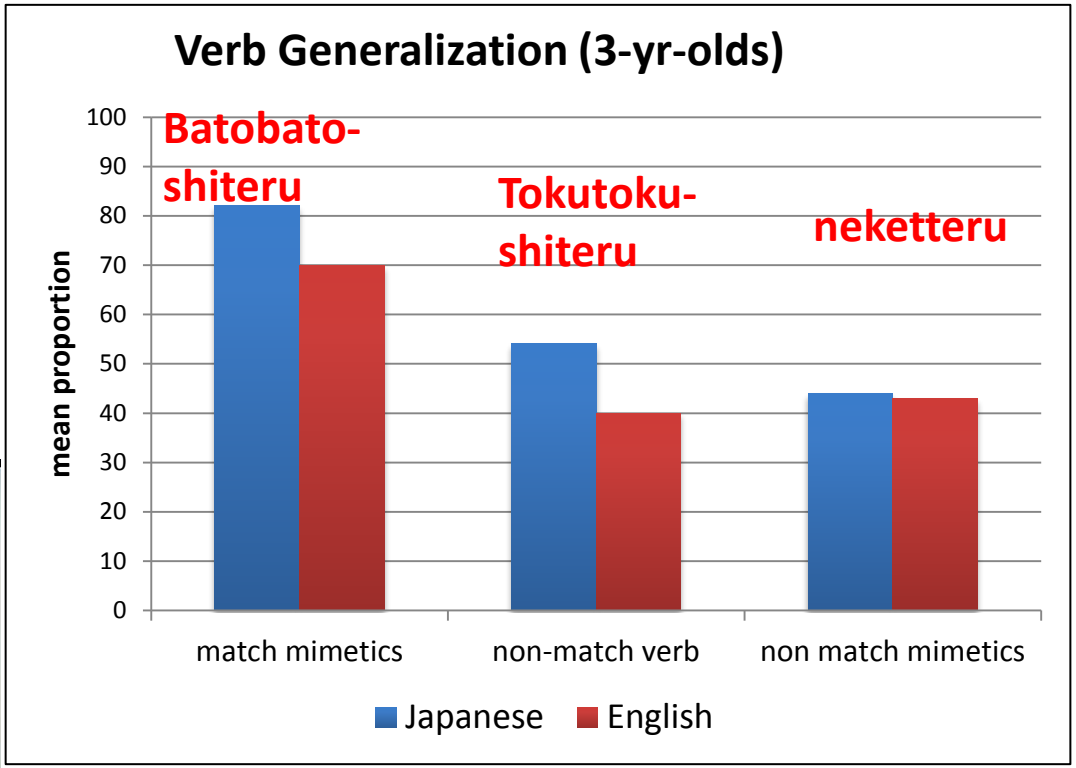


Asano et al.,2015, *Cortex*

Sound symbolism helps novel verb generalization in Japanese- and English-reared children



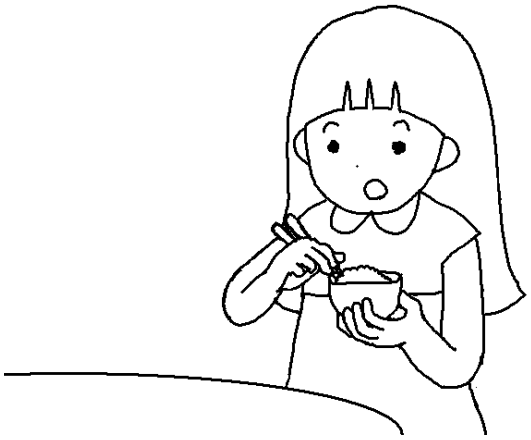


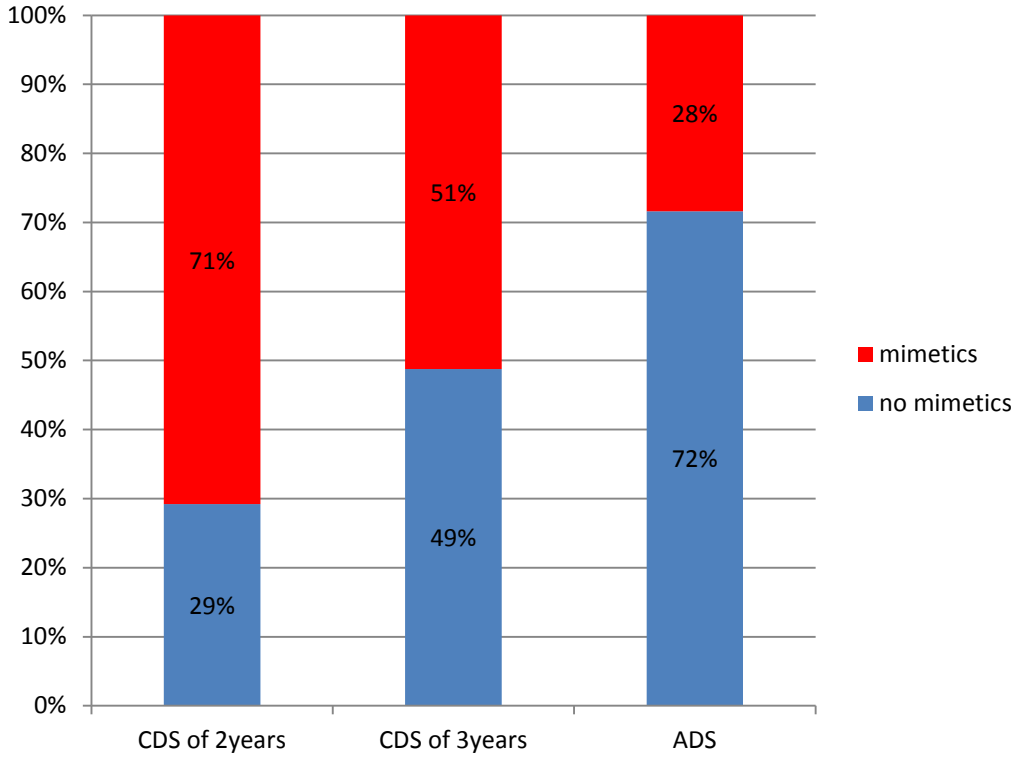


Imai et al.,2008, Kantartzis, 2011

Parents use more sound symbolic words for younger children to scaffold them into conventional language (cf. Murasugi, in this conference)

Mimetic use in CDS and ADS (Saji, Akita& Imai, in prep)





- Mothers used more mimetics in CDS
- The younger the children, the more mimetics produced by care-takers

A Puzzle

- At a global level, across languages, statistically significant form-meaning regularity is found (Monaghan et al., 2014; Dautriche et al., 2016)
- L2 learners can map sound symbolically matching words better than non-matching words (Iwasaki& Yoshioka's talk)

- Sound symbolic words in a language is not transparent to non-native speakers at least consciously. (cf. Doctors from outside Tohoku could not understand mimetic expressions of pain, Herlofsky)
- Even advanced L2 learners experience difficulty in learning mimetics (Iwasaki & Yoshioka)

- **ttipi-ttapa**
- **xurrut**
- **diz-diz**
- **tokotoko**
- **chibichibi**
- **kirakira**

To what extent is sound symbolism universal and iconic?

- Most previous studies assumed that sound symbolism found in a study using a particular language sample is applied to other languages.

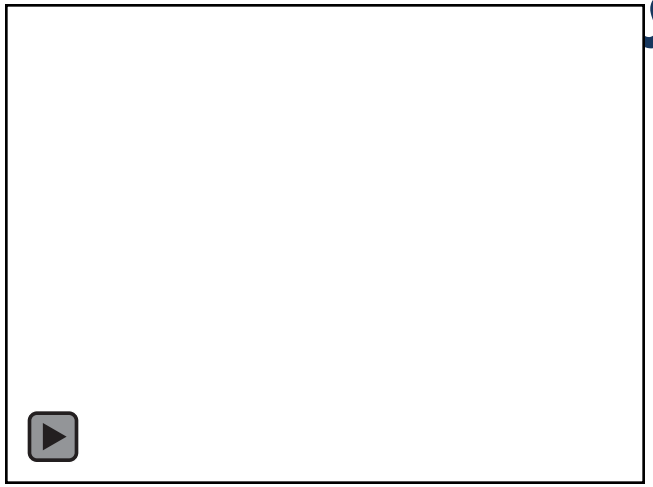
- Sound symbolism was mostly tested in a hypothesis-testing fashion⇒We could not know in what degree sound symbolism in one language is shared across languages

We conducted an experiment to examine what sound-meaning correspondences are used in speakers of English and Japanese, without limiting our selves in those that have been pointed out in the literature

Sound symbolism for motion in Japanese and English (Saji, Akita, Kantartzis, Kita, & Imai, under review)

- General scheme

Rating data set



Sound data set

- **Rating task**: rating motion videos:
  size (large <-> small)
  speed (slow <-> fast)
  weight (heavy <-> light)
  energeticity (energetic <-> not energetic)
  jerkiness (jerky <-> smooth)

- **Production task**: producing sound-symbolic words (C1V1C2V2)
  - The 1st mora (C1V1) was fed into the analysis

Coding

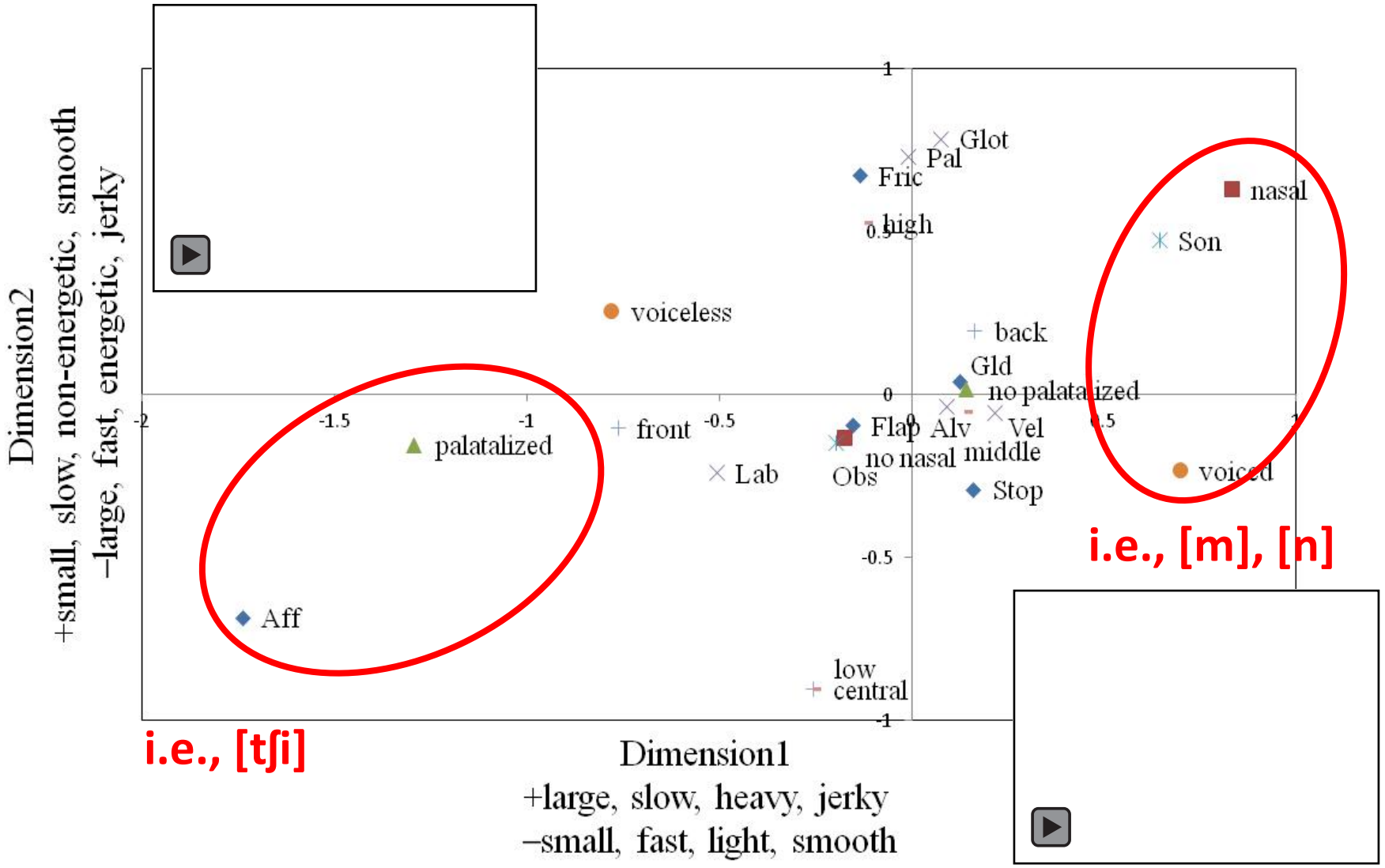
- Japanese
  - “syaka” -> C: “sy”: Alveolar, Obstruent, Fricative, Voiceless palatalization,nasal,
    V: “a”: low central
  - “zushi” -> C: “z”: Alveolar, Obstruent, Fricative, Voiced, no palatalization, no nasal
    V: “u”: high, back
- English
  - “gine” -> C: “g”: Velar, Obstruent, Stop, Voiced
    V: “I”: front, high
  - “colo” -> C: “c”: Velar, Obstruent, Stop, Voiceless
    V: “o”: back, mid-high

(based on Bailey & Hahn, 2005)

Participants recruited the inventory of phonetic features in the conventional lexicon in their native languages

- We calculated the number of occurrences of each value in each phonetic feature with their distributions in spoken Japanese and English in the corpus (Maekawa, 2003 for Japanese; Denes,1963 for English; cf. Talks by Nasu and Kubozono in this conference).
- Japanese: r = .85
- English :r = .83

Sound-Meaning Associations in JP
A Canonical Correlational Analysis



Sound-Meaning Associations in ENG
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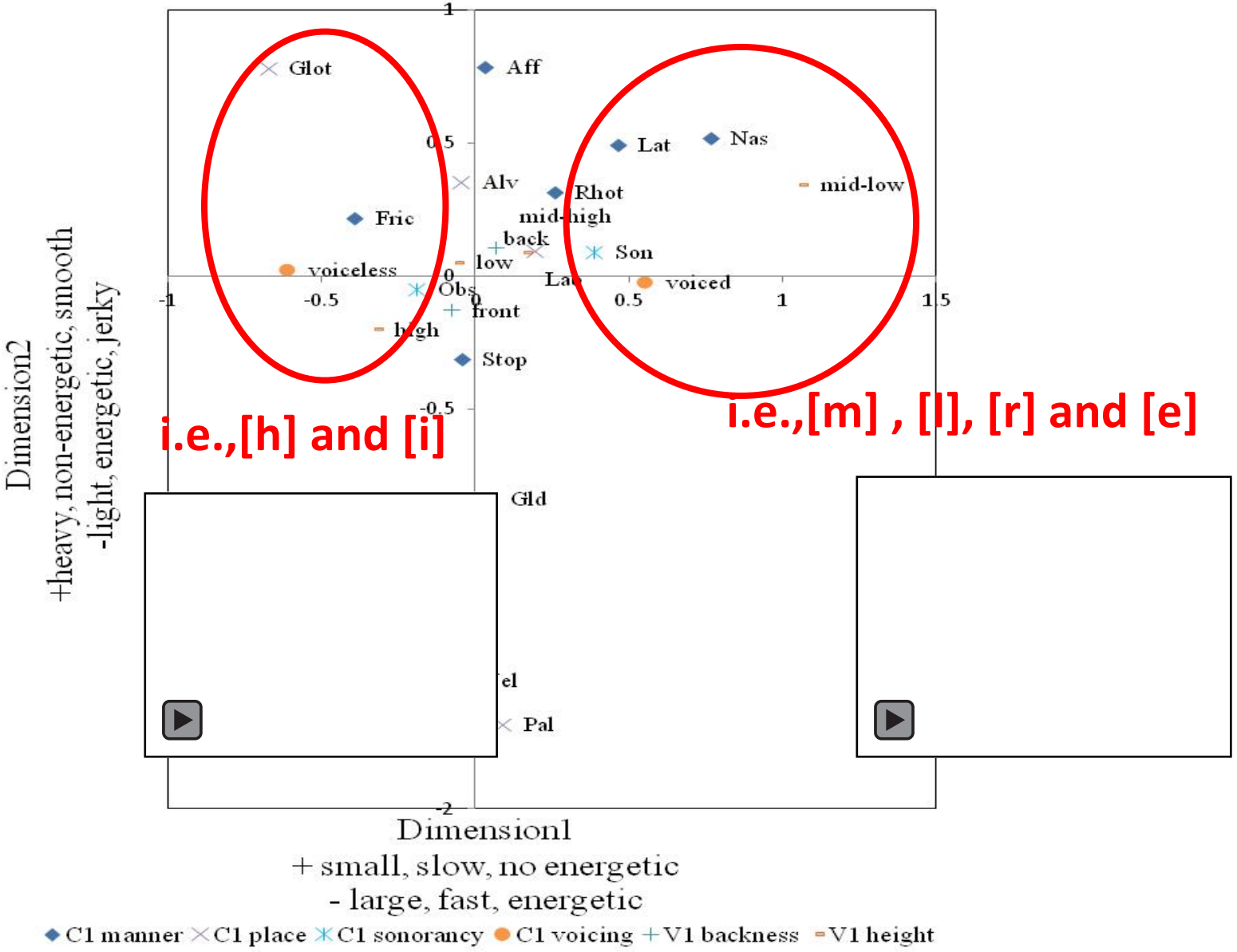
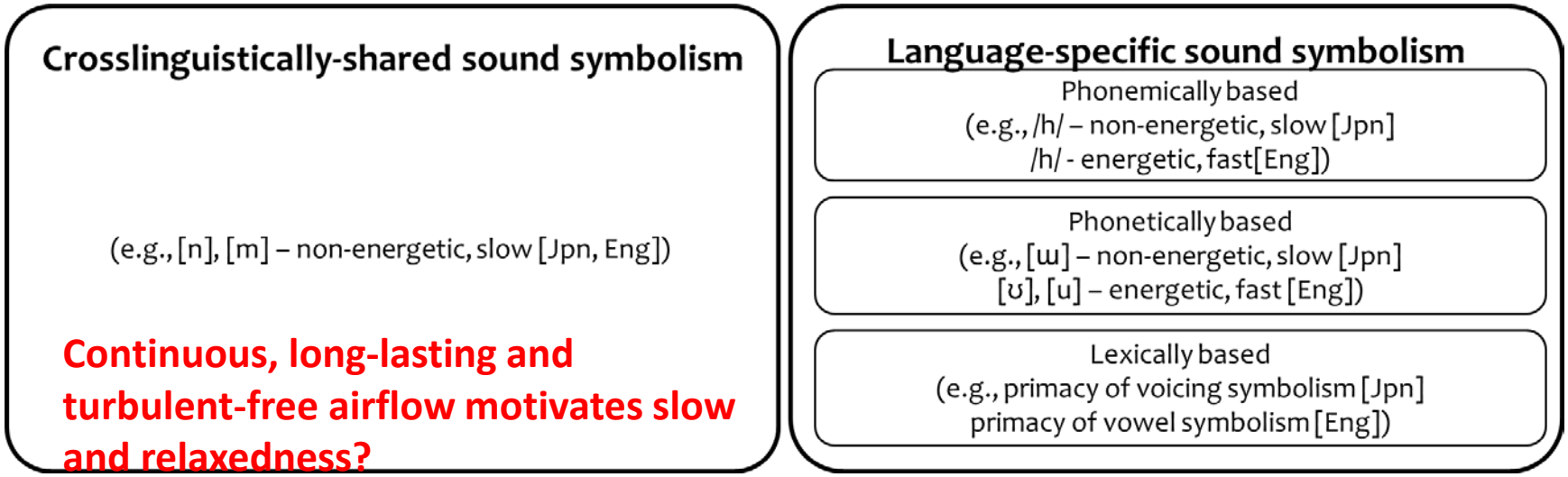


Shared and language-specific sound-meaning associations in Japanese and English

Language	Dimension	Sound-meaning correspondences	
Japanese	Dimension 1	LIGHT, SMALL	HEAVY, LARGE
		voiceless (.73), palatalized (.41), affricate (.98)	voiced (−.87), sonorant (−.58), nasal (−.65)
	Dimension 2	FAST, ENERGETIC	**SLOW, NON-ENERGETIC**
		labial (.62), velar (.46), stop (.47), low vowels (1.3), central vowels (.69)	**nasal (−1.1),** affricate (−.60), glottal (−.74), high vowels (−.28), back vowels(−.32)
English	Dimension 1	**SLOW, NON-ENERGETIC**	FAST, ENERGETIC
		voiced (.55) , sonorant (.39) nasal (.77), lateral (.46), mid-low vowels (1.1),	voiceless (−.61), glottal (−.67), fricative (−.40), high vowels (−.33)
	Dimension 2	HEAVY, SMOOTH	LIGHT, JERKY
		glottal (.78), affricate (.79)	palatal (−1.7), velar (−1.5), glide (−.84)

Cross-linguistically shared and language-specific sound symbolism in Japanese and English



Sound-Meaning Associations are mostly language specific

Summary

- Sound symbolism is situated in the phonological environment of each language (Cf., Talks by Nasu, Hamano, Kubozono)
- Hence, most sound-meaning associations are language-specific

Implications for Language Evolution and the Symbol Ground Problem

- In our ancestors' language, most words may have been sound symbolic (Arbib, 2005; Ramachandran & Hubbard, 2001; Kita et al., 2010)
  - Subtle but consistent sound-meaning correspondences in languages in the large scale lexicon (Monaghan et al., 2014; Dautriche et al., 2016)
  - Role of sound symbolism for language development
- However, as language evolves and expands the lexicon, arbitrariness becomes important. (Monaghan et al., 2011, Dingemanse et al., 2015)

Iconicity⇒Arbitrariness⇒Systematicity

- Expansion of the vocabulary makes it difficult to maintain directly perceivable iconicity between form and meaning
  ⇒Pressure to push language toward arbitrariness

- Repeated language transmission turns an arbitrary lexicon into a systematic one (e.g., Kirby et al., 2008).
  ⇒Pressure to push arbitrary language toward regularity

Systematicity⇒Secondary Iconicity

- People's sense of similarity is malleable and context dependent
  - Dog and doghouse (spatial contiguity: Saalbach & Imai, 2007)
  - Golf club and cucumber (because they belong to the same classifier category: Saalbach & Imai, 2007, 2011)
- Thus, once form-meaning regularity arises, similar forms can create sense of similarity in meanings

⇒Pressure to create iconicity

Modern language stands at an optimal balance

- Through its evolution, language may reach at the optimal balance between iconicity and arbitrariness due to the two forces working simultaneously.
- The “optimal level” is likely to be different across different concepts.
  ⇒Uneven distribution of iconicity across different semantic domains and different part of speech

(e.g.,Hamano 1998: Dingemanse, 2012; Akita, 2009, Imai & Kita, 2014)

This is why it is difficult to draw a clear line between mimetics and non-mimetic words

- When non-mimetic words take these forms, non-sound symbolic words sounds like mimetics, which creates the sense of iconicity.
  - *Siwa-siwa* (*siwa* is not a mimetic but Japanese speakers feel like siwasiwa is a mimetic due to reduplication)
- When originally mimetic words are transformed into the form of conventional words, perceived iconicity gets attenuated.
  - Yuru-yuru vs. yurui

The Symbol Grounding Problem in lexical development

Q: How do children break into language, which is a system of abstract symbols (words)?

A: Biologically endowed ability to map sound and vision leads children to gain insights that speech sounds refer to things or events in the world

The Symbol Grounding Problem in lexical development

Q: How do children acquire abstract meanings of words without falling into the symbol to symbol Merry-Go-Around ?

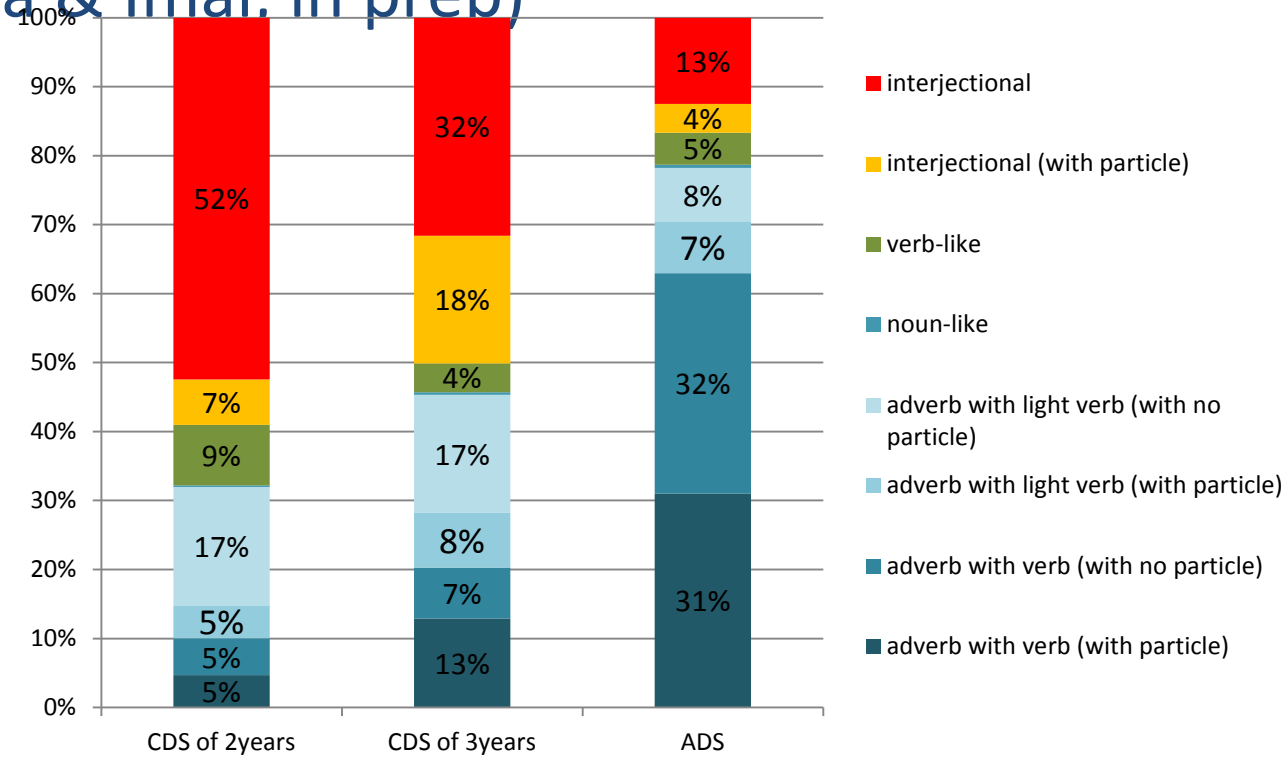
A: Through gradually finding out the systems of the ambient language in sound, meaning, grammar, and how these elements are mapped one another.

How Japanese mimetics helps language acquisition?

- **The meaning of mimetics can be easily inferred from its form (sound).**
- **Mimetics have combinatory properties**
- **Mimetics are constrained by phonological, prosodic, morphological, structural and lexical rules/distributions (Most of the presentations of this symposium).**

- **More important, mapping between each linguistic element and meaning may be more transparent in mimetics/motherlese.**
  - **Diminutives in Czech is heavily used in CDS for size SS. Gender class is often ambiguous in other forms but it is clearest in the diminutives (Ueda Fidler, personal communication)**
  - **Cvak vs. Cvakout?? (Ueda Fidler's talk)**
  - **Poi-ta (Murasugi's talk)**

Mimetic use is gradually integrated into the conventional language system with development (Saji, Akita & Imai, in prep)



Interjectional use: e.g. , “Arere(oh), mite(look). *poroporoporoporo* (mimetics). Arerere(oh)”
Adverbial use : e.g., “onnanoko-ga(a girl) gohan-wo(her meal) *poroporo*-to koboshichatta (has dropped)”

- CDS (interjectional) <-> ADS (adverbial)
- As iconic expression of sound (or manner) ->as linguistic part

Symbol grounding is not just a process of hooking symbols to sensory experience.

Equally important aspect of the SGP is how children can **deground symbols from body without losing the sense of groundedness**

Sound symbolism, especially mimetics/ideophones/expressives helps this process

Thank you!

- Collaborators

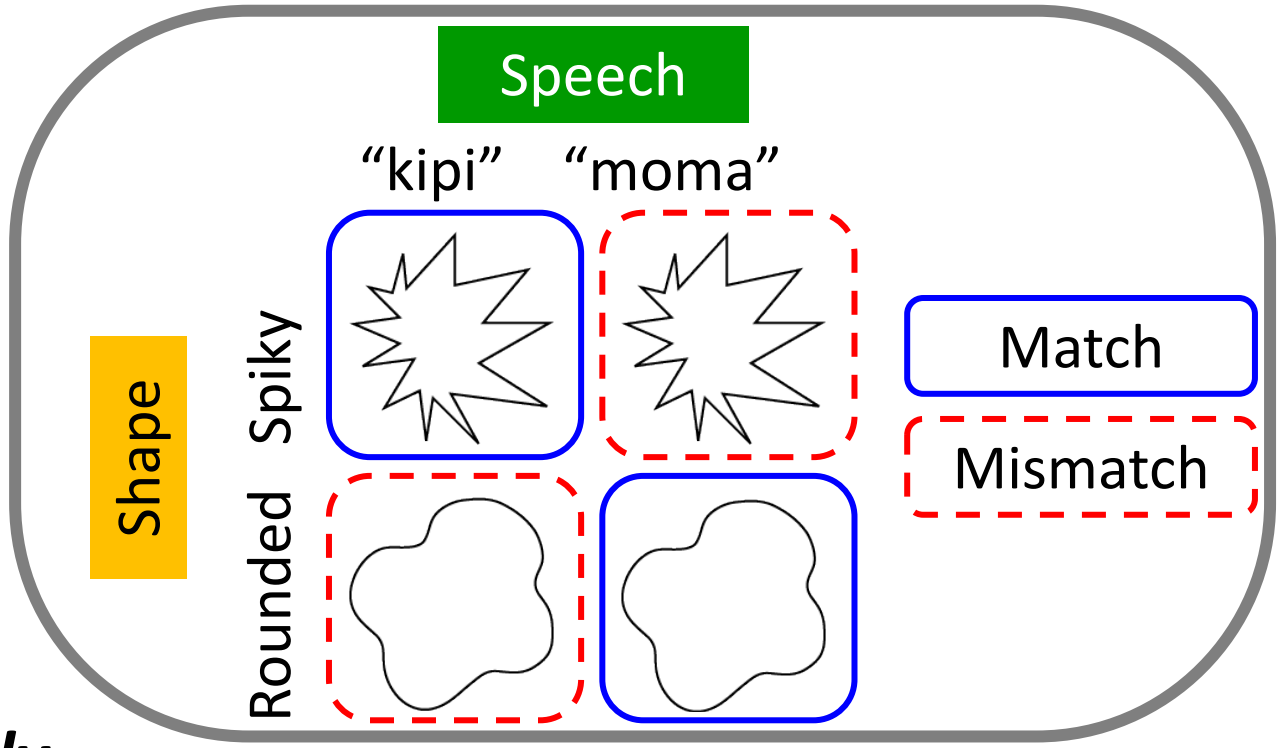
Noburo Saji, Kimi Akita, Sotaro Kita, Katerina Kantartzis, Michiko Asano, Michiko Miyazaki, Keiichi Kitajo, Guillaume Thierry

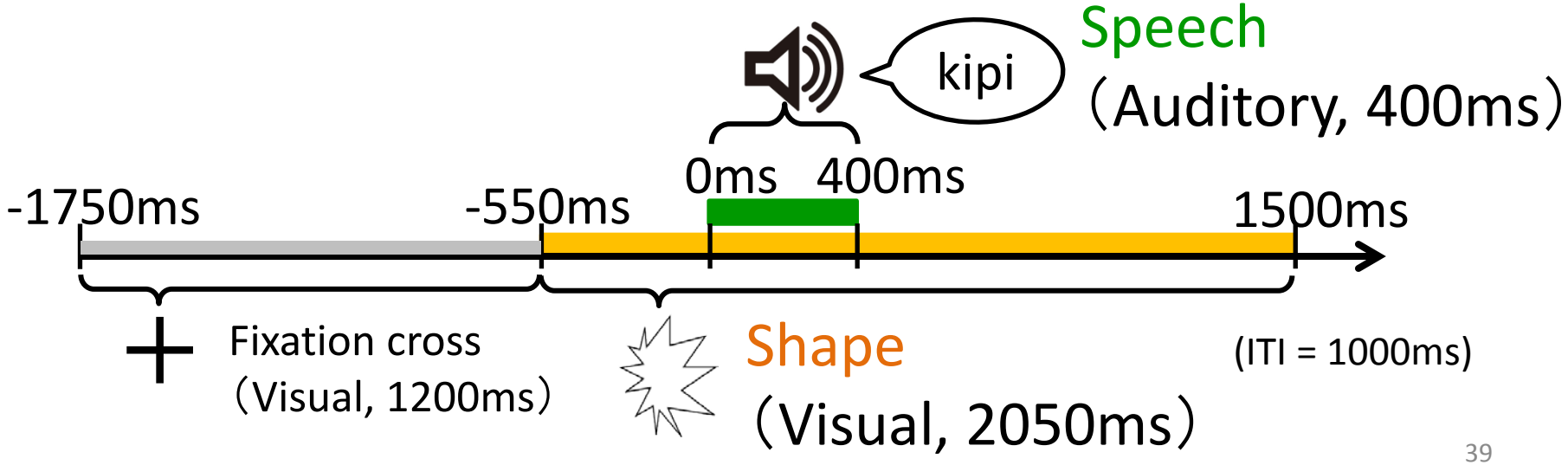
Extras

Protocol

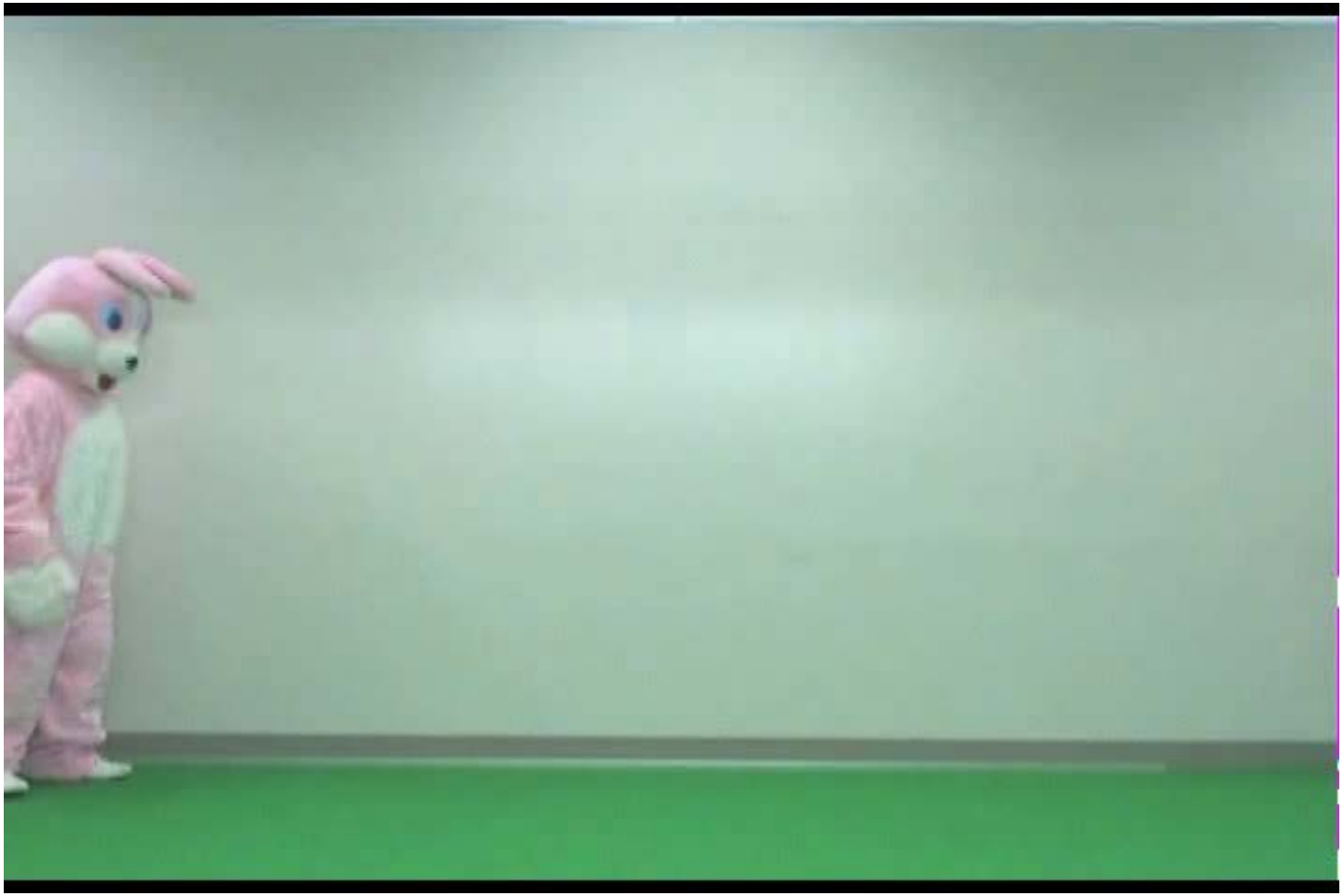
Task:

Participants watched and listened to the stimulus *passively*.

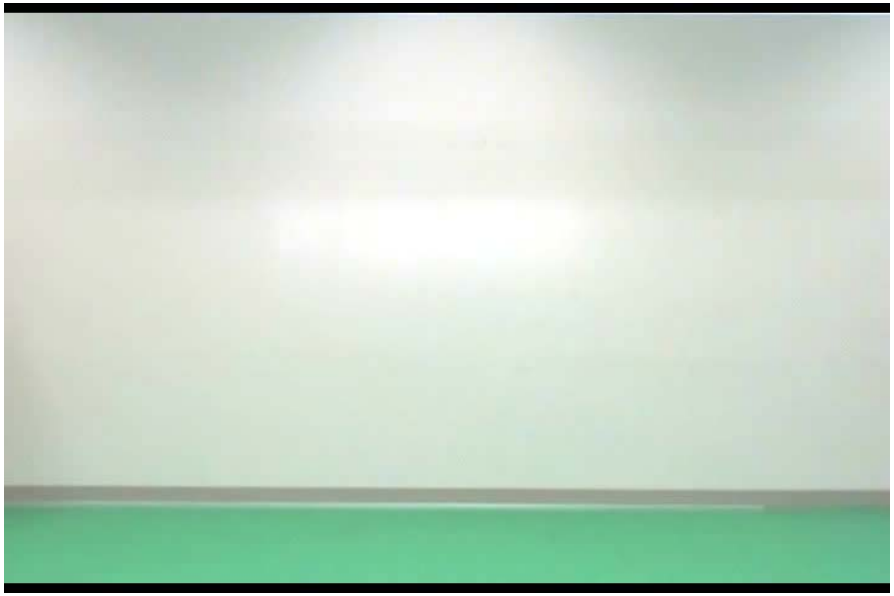




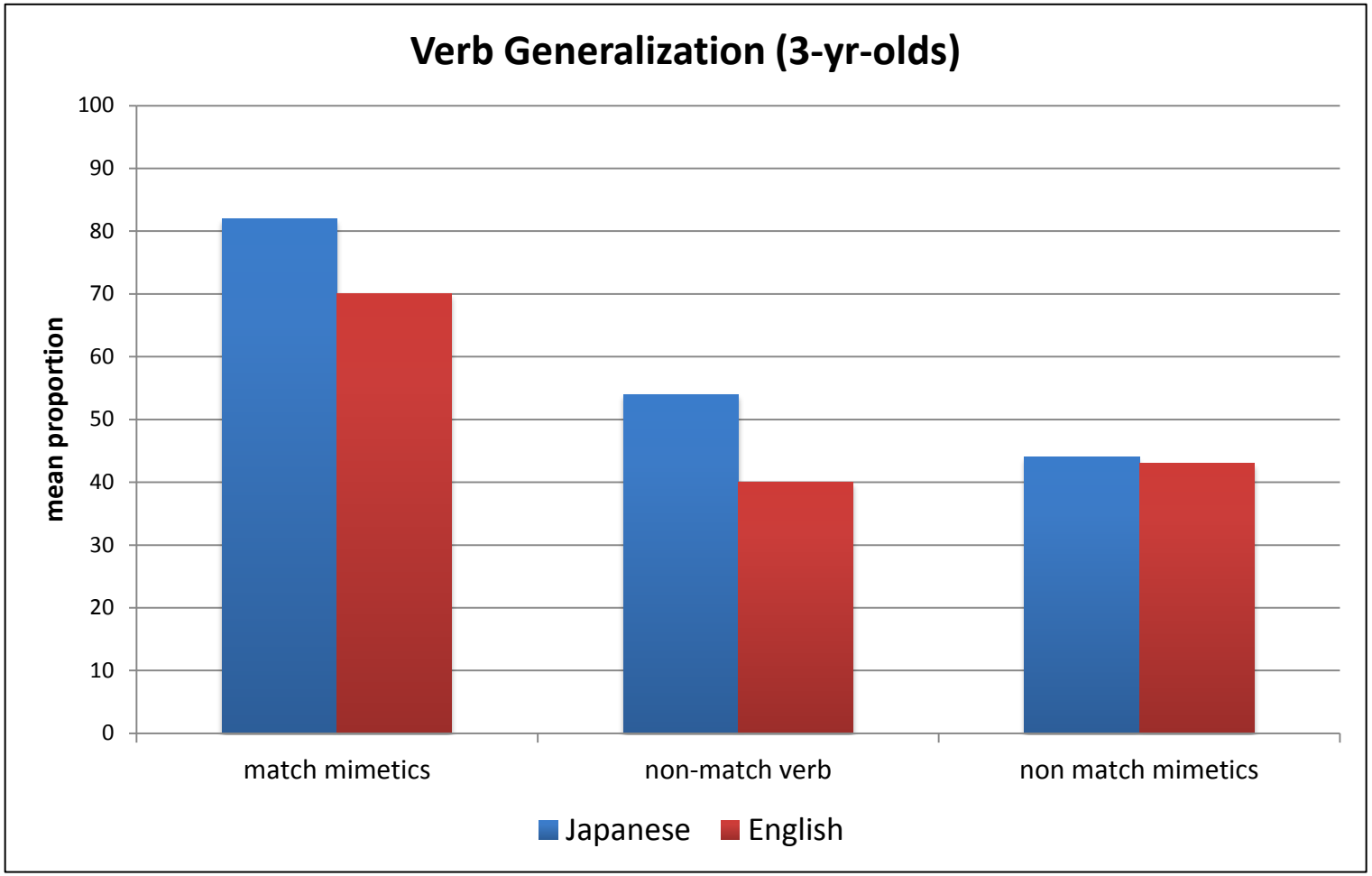
SS helps Novel verb generalization



Imai et al., 2008, Kantartzis et al., 2011



Sound symbolism helps novel verb generalization in Japanese and English children



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ADS VS CDS

- CDS (Child Directed Speech)

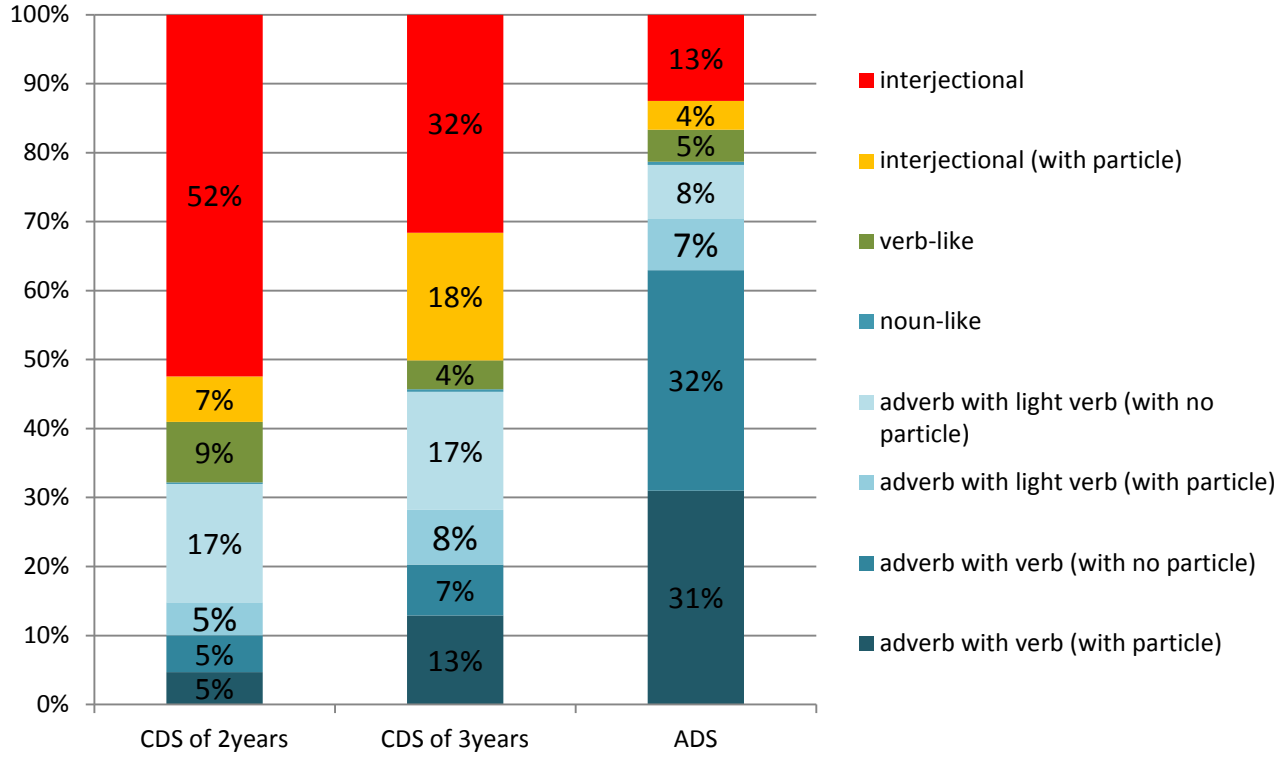
SubA.

"A(oh), gohan-taberu-kedo (she is having her meal but), *poroporopopoporo* , okkochi-tyatta (she has dropped it).
Jyouzu-ni (skillfully) ohashi-ga (her chopsticks) tsukae-nai-n-dane (she cannot use).
Poroporoporoporo-tte.
A(oh), gohan-ga (her meal) okkochi-tyatta (dropped). *Korokorokorokoro*-tte"

SubB.

"Onee-chan(she) gohan-tabeteru-yo (is having her meal). *Poroporoporo*.
Arerere(oh). Mitemite-hora (look). Okuchi-kara (from her mouth) de-chatta (her meal has gone). *Poroporoporoporoporo*. Arerere (oh).
Are(oh), jyozu-ni(well) tabe-rare-nai(she cannot eat). *Poron, poron*, *poroporon*.
Ara(oh), okkochi-tyatta(dropped)"

Mimetic use is integrated into theconventional language system with development



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Primary and Secondary Iconicity

Sonesson (1997), Ahlner & Zlatev, (2010)

- Primary iconicity
  ⇒we can readily perceive similarity between form and meaning without prior knowledge that the form and the meaning constitute a sign.
- Secondary iconicity
  ⇒ prior knowledge makes us to perceive similarity between the two

The two types of iconicity are not dichotomously divided concepts. They are on a continuum.