言語はなぜ身体的でかつ恣意的なのか—「類像性の輪」仮説
(the iconicity ring hypothesis)

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Important thesis of language

- The relation between word form and meaning is arbitrary.
- However…

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Language contains iconicity

- Even conventional vocabulary contain systematic correspondence between sound and meaning (Blasi et al., 2016)
- Early acquired words have higher systematic correspondence between word sound and meaning (Monahan et al., 2014)
- In Infant Directed Speech, mothers use more onomatopoetic words and mimetics to younger children (Laing et al., 2016; Saji et al., 2013)

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An important question

- **How do children use iconicity to anchor their experience to language, and how do they go beyond iconicity to acquire abstract linguistic systems?**

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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).**

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Plans of my talk

- **Present evidence for symbol grounding using iconicity**
  - **language learning starts from biologically endowed iconic experience between speech sounds and referents**
    ⇒ Brain response for sound symbolic words
- **Present a case for deviation from universal iconicity**
  - **much of sound symbolism is language-specific**
    ⇒Cross-linguistic comparison of sound symbolic word production
- **Explore**
  - how language is abstract but embodied simultaneously
  - implications for language evolution

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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).

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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)

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What is embodiment?
What is iconicity?

- Is iconicity necessarily universal and accessed easily?
- **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 once we consider the range of things they can refer to.**

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The Reframed Symbol Grounding Problem

- 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

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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*)
4. Sound symbolism are in part processed as environmental sound in the brain (Kanero et al., 2014, JML)

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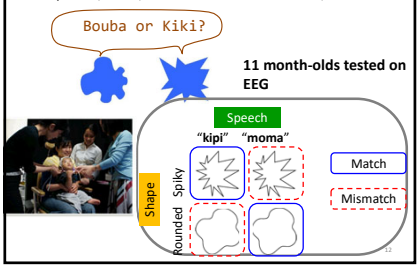
The Bouba-Kiki effect

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



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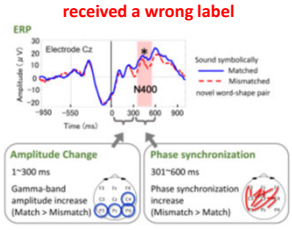
11 month-olds' brain treated a mismatching novel sound-shape combination as if the shape received a wrong label



Asano et al.,2015, *Cortex*

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Use of sound symbolism in IDS

- Early acquired words have higher systematic correspondence between word sound and meaning (Monahan et al., 2014)
- In Infant Directed Speech, mothers use more onomatopoetic words and mimetics to younger children (Laing et al., 2016; Saji et al., 2013)

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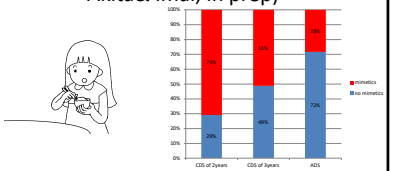
Mimetic use in CDS and ADS (Saji, Akita& Imai, in prep)



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

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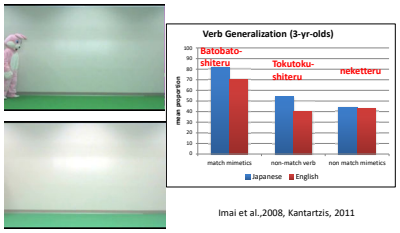
Sound symbolism helps novel verb generalization in Japanese- and English-reared children



Imai et al.,2008, Kantartzis, 2011

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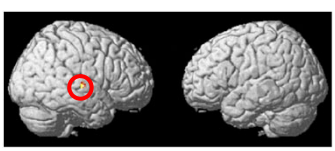
Evidence for embodiment of sound symbolism in the brain (Kanero et al., 2014)

Right pSTS (where multi-modal information is integrated and envitonmental sound is processed, Thierry etal, 2003) was activated for sound symbolic words



obtained through conjunction analysis with the images of [Mimetics – Adverb] & of [Mimetics – Verb]

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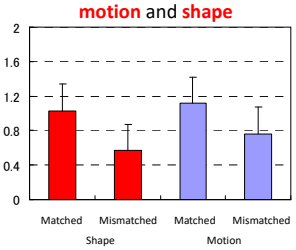
Activation of the right pSTS both for **motion** and **shape**



The rSTS (62, -38, -2) activation using ROI analysis. The error bars indicate the SD

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- 11 month-old infants showed activation of the same loci (right p-STS) for the sound symbolically matching case (e.g., Moma→round shape), when tested on NIRS (Near Infrared spectroscopy)

(Yang et al., 2019, Scientific Reports)

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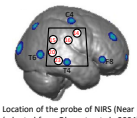
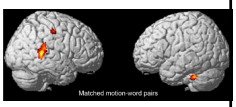
Comparison between adults (fMRI) and infants (fNIRS) Yang et al., 2019

Infants fNIRS



Location of the probe of NIRS (Near Infrared spectroscopy (adopted from Okamoto et al., 2004).

Adults fMRI (Kanero et al., 2014)



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A Puzzle

- At a global level, across languages, statistically significant form-meaning regularity is found (Blasi et al., 2016; Monaghan et al., 2014; Dautriche et al., 2016)

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- Sound symbolic words in a language is not transparent to non-native speakers at least consciously.
- Even advanced L2 learners experience difficulty in learning mimetics (Iwasaki & Yoshioka, 2017)

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

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Sound symbolic words contradicting universal tendencies (or intuition)

- Magnitude sound symbolism
  - *mal* vs. *mil* (Sapir 1929)

- Reversal mappings in some languages
  - Korean (Altaic; Kim, 1977;Kwon, 2015, p. 80), Bahnar (Austroasiatic; Diffloth, 1994), Rengao (Austroasiatic; Gregerson, 1984), and Nembe (Niger-Congo; Maduka, 1988)

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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 do 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

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Sound symbolism for motion in Japanese and English (Saji, Akita, Kantartzis, Kita, & Imai, 2019, PLoS One

- General scheme

- **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

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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)

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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).
- **Japanese: *r* = .85**
- **English :*r* = .83**

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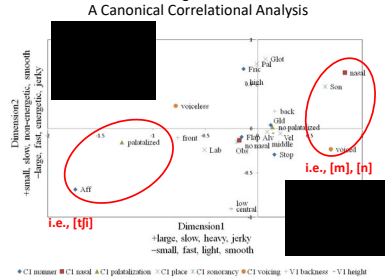
Sound-Meaning Associations in JP A Canonical Correlational Analysis



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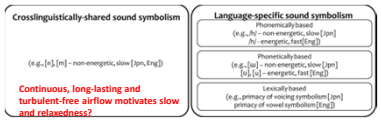
Cross-linguistically shared and language-specific sound symbolism in Japanese and English



Sound-Meaning Associations are mostly language specific (cf. primary vs. secondary iconicity: Ahlner & Zlatev, 2010)

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Summary

- Sound symbolism is situated in the phonological environment of each individual language
- Hence, most sound-meaning associations are language-specific
- The "bouba-round" and "kiki-spikely" sound symbolism may be an exception.

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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 (Blasi et al., 2016; 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)

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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

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Systematicity⇒Secondary Iconicity

- People's sense of similarity is malleable and context dependent
  - Dog and doghouse (spatial contiguity: Saalbach & Imai, 2007)
- Thus, once form-meaning regularity arises, similar forms can create sense of similarity in meanings

⇒Pressure to create secondary iconicity
(Ahlner & Zlatev, 2010)

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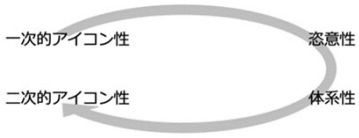
Iconicity Ring Hypothesis



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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

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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)

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Why are some languages have rich inventory of mimetics/ideophones and other do not?

- It may depend on how much the language integrate mimetics into morpho-syntactic systems to productively create new mimetic words
  - Satellite Framed Languages vs. Verb-Framed languages

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

Equally important aspect of the SGP is how children can **de-ground symbols from body without losing the sense of groundedness (sense of embodiment)**

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

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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 of the Japanese language**

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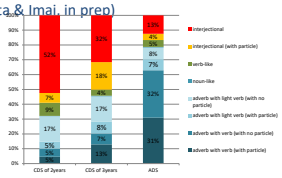
Mimetic use is gradually integrated into the conventional language system with development (Saji, Akita & Imai, in prep)



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

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

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- **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)**
  - **Poi-ta (Murasugi personal communication)**

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Thank you!

- Collaborators

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