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Phonology Across the World's Languages

Phonology Across the World's languages

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I investigated these themes: (1) Examining efficiency of a new cueing task in combination with EEG. (2) Examining priming for low and high-proficient bilinguals (LPB/HPB) when naming English words. (3) Examining which phonological unit is used when naming Kanji compounds. (4) Examining whether the cross-language variation in the size of the unit of word production is due to the type of script used in the language. (5) Constructing an online database which contains information about Japanese kanji and their pronunciations together with their on-reading ratios. From these investigations, I found that low proficient JP-ENG bilinguals use their L1-unit (mora) to construct speech sounds even in their L2 (English). Conversely, high-proficient JP-ENG bilinguals use the same unit as a native speaker (English). Also I found that kanji can influence the unit of language production. That is, mora overlap might not be enough and the whole pronunciation of the kanji becomes the relevant factor.

psycholinguistics phonology language psychology linguistics experimental production ee g

１．研究開始当初の背景

There are over 6000 different languages in the world and most sound differently. Thus, it is important to understand how speech sounds (phonology) are constructed. Several theoretical models have emerged attempting to describe language production processes and concur that there is a clear division between processing the meaning of words and processing the sound forms of words. The most detailed model of language production [1] proposes that we first form thoughts we want to express. Next, we process the syntax of the words involved and lastly, we construct the sound forms of the words.

Fig. 1. Part of the Levelt et al. (1999) language production model.
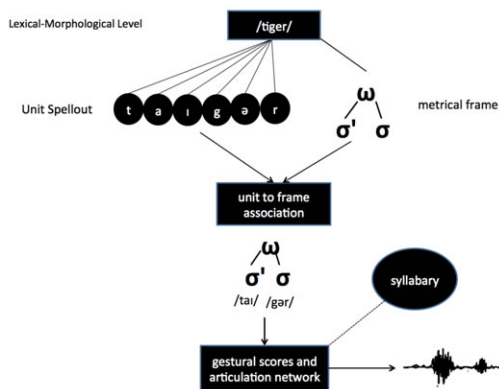
As can be seen in Figure 1 this latter part is further divided into a "*units*" and a "*frame*" part. The frame specifies how many syllables are needed and to which stress (and/or tone/pitch in certain languages) is added and the "units" represent the fundamental sound units to fit in the metrical frame. These "units" have typically been assumed to be phonemes, though recent evidence has shown that this might be different in Chinese [2] in which the syllable, and Japanese [3] in which the mora has been proposed to be the fundamental phonological building blocks during language production. However, how speech sounds are exactly produced is still debated, especially concerning the exact differences for several languages as well as the current scarcity of information concerning the underlying brain mechanisms.

２．研究の目的

The purpose of this research project is to enhance our knowledge concerning how speech sounds are constructed by the brain among the various languages in the world. These findings are academically very important for theoretical models defining the architecture of language processing [1]. Additionally, there are also many real-world applications such as those found in language education, speech pathology, and human-machine interaction.

３．研究の方法

This research project has employed several experimental paradigms to investigate this matter. First, the cueing paradigm (see Figure 2) in which two cues are presented which overlap in a phoneme (e.g. /k/ in 亀-骨) or mora (e.g. /ka/ in 亀-壁) versus no overlap (e.g. 亀 - 机). Hereby we also employed electroencephalography (EEG).
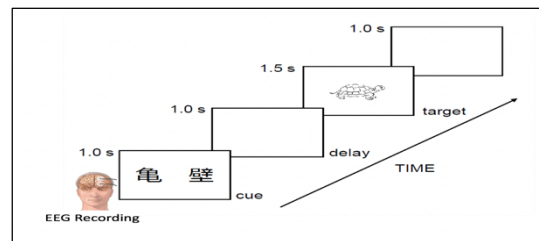

Fig. 2. The cueing paradigm.

Second, we investigated how the phonological unit would manifest for low- and high-proficient Japanese‐English bilinguals using a masked priming paradigm. Third, using a similar masked priming paradigm we investigated the role of script (kanji vs. kana) on the observed priming processes as both scripts are likely to have different processing strategies. Fourth, we used the Stroop task and investigate this matter the matter of script type on the phonological unit even closer. Fifth, in an effort to increase phonological onset detection accuracy, we employed new techniques using the MS Kinect sensor to obtain chronometric onset data based on lip movement as well as on auditory information.

４．研究成果

First, I have carried out several experiments using the cueing paradigm in combination with EEG (with Prof. Tamaoka at Nagoya University). This work is still in progress as we found mixed results (some experiments showed facilitation, whereas others did not). We are adapting the task to maximize results. Second, I have co-authored a paper (Nakayama, Kinoshita & Verdonschot, 2016) investigating priming

for low- and high-proficient bilinguals (LPB/HPB) when naming English words. Stimuli overlapped in the onset (bark - BENCH vs. dark - BENCH) or in the mora/CV (bell - BENCH vs. cell - BENCH). We found that only HPB and native speakers showed onset priming but not LPB. All groups showed (identical) CV and identity priming. We also found that immersion (not TOEIC score or onset of learning) explained this pattern best. An acoustic analysis (see Figure 3) finally showed that only LPB (and not HPB) JP-ENG bilinguals inserted vowels in English words (e.g. magnet becoming maGUnet[to]) which fits the assumption that low-proficient bilinguals use mora units even in their second (low-proficient) language.
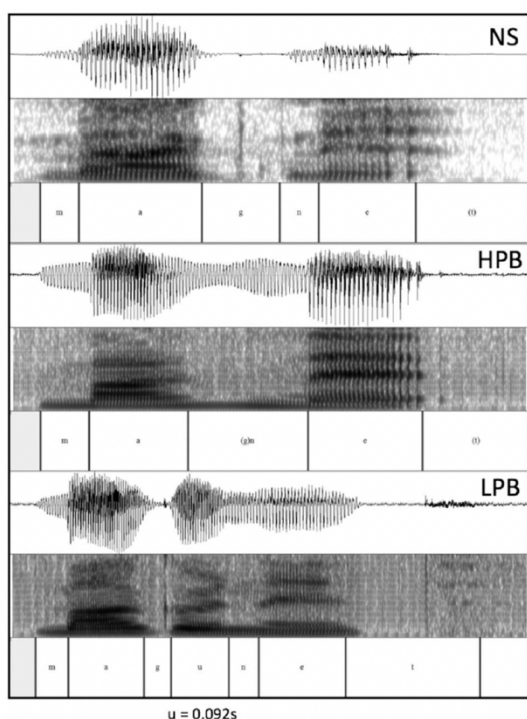

Fig. 3. The insertion of epenthetic vowels by low-proficient JP-ENG bilinguals.

Third, I have co-authored a publication (Yoshihara et al., in press) which used the masked priming paradigm to examine which phonological unit is used when naming Kanji compounds. Although the phonological unit in the Japanese language has been suggested to be the mora [3], we found that significant priming only when Kanji pairs shared the whole sound of their initial characters. This paper discusses how different phonological units may be involved when processing Kanji and Kana words as well as the implications for language production models. Fourth, I investigated whether the cross-language variation in the size of the unit of word production is due to the type of script used in the language (i.e. alphabetic, morphosyllabic, or moraic) as shown by the previously mentioned Yoshihara et al. (in press) data. Through the use of the Stroop colour naming task, we showed that the overlap in the initial mora between the colour name and the written distractor facilitates colour naming independent of script type. These results (re-)confirm the mora as the phonological unit of word production in Japanese [3], and also establish the Stroop colour naming task as a useful task for investigating the fundamental (or "proximate") phonological unit used in speech production. Fifth, based on a KINECT publication (Verdonschot et al. 2015) we carried out additional investigations (with Dr. Fujie from Chiba Institute of Technology) using a deep learning approach. This research is still in progress as the current models could not predict the sensor data with high accuracy. Therefore, a higher resolution sensor is currently being employed. Lastly, I have co-authored a publication (Tamaoka, Makioka, Sanders & Verdonschot, 2017) which provides a new and freely accessible database for scholars to use when working with the Japanese language. This database is very useful when selecting stimuli to investigate the production of speech sounds in Japanese as multiple readings for different kanji are listed together with their "on ratio" (i.e., how often a kanji is read in its on- or kun reading).

<引用文献>
(1) Levelt et al. (1999) - *Behav. Brain Sc.*
(2) O' Seaghdha et al. (2010) - *Cognition*
(3) Verdonschot et al. (2011) - *JEP:LMC*

５．主な発表論文等
（研究代表者、研究分担者及び連携研究者には下線）

〔雑誌論文〕（計５件）

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②Yoshihara, M., Nakayama, M., Verdonschot, R.G., & Hino, Y. (in press). The phonological unit of Japanese Kanji compounds: A masked priming investigation. **Journal of Experimental Psychology: Human Perception & Performance.**

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④Nakayama, M., Kinoshita, S., & Verdonschot, R.G. (2016). The Emergence of a Phoneme-sized Unit of Speech Planning in Japanese-English Bilinguals. **Frontiers in Psychology**. 7:175.
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⑤Verdonschot, R.G., Guillemaud, H., Rabenarivo, H., & Tamaoka, K. (2015). The Microsoft KINECT: a novel tool for psycholinguistic research. **The Open Journal of Modern Linguistics**. 5, 291-301.
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〔学会発表〕(計 2 件)

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②Yoshihara, M., Nakayama, M., Verdonschot, R.G., & Hino, Y. 「The Phonological Unit of Japanese Kanji Words.」57th Annual Meeting of the Psychonomic Society (Boston MA, USA, November, 2016)

〔図書〕(計 2 件)

①Schiller, N.O., & Verdonschot, R.G. (accepted for publication). Morphological Theory and Neurolinguistics. In Audring, J. & Masini, F. (Ed.), Oxford Handbook of Morphological Theory. Oxford University Press.

②Schiller, N.O., & Verdonschot, R.G. (2015). Accessing words from the lexicon. In J. Taylor (Ed.), The Oxford Handbook of the Word. Oxford: Oxford University Press. ISBN: 978-0-19-964160-4.

〔産業財産権〕

○出願状況 (計 0 件)

○取得状況 (計 0 件)

〔その他〕

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