Exploring synesthetetic sound symbolism: An explicit and an implicit approach on size-sound correlation
The relationship between the sound and the meaning of a word is an arbitrary one.

There are also cases in which we can observe a direct relationship between sound and meaning. → Certain sounds are directly associated to certain meanings.

Sound symbolism:
A process by which characteristics of external referents are correlated systematically to specific articulatory or acoustic properties of sounds.
Sound symbolism related to the concept of “size”

What process is involved in correlating sounds to non-auditory characteristics?

“Size”
Visual characteristic

Voicing of consonants

Phonetic features of vowels

Articulatory phonetic theory

- The pronunciation of different phonemes results in a relative size change in the articulator (mouth and throat), which is perceived by the speaker and correlated to a size change in the referent.

Acoustic phonetic theory

- Low frequency sounds are associated with larger resonators, which in turn correlate to larger emitting sources, than high frequency sounds. → Consonants and vowels with lower frequencies are associated with bigger referents.
Consonants

Articulatory phonetic theory

When pronouncing voiced consonants, speakers expand their oral cavity. (Ohala 1979)

Voiceless (/p·t·k·s/..) < Voiced (/b·d·g·z/..)

Acoustic phonetic theory

Compared to voiceless consonants, voiced ones create vibration of the vocal cords, and contribute to lower the frequency of adjacent vowels. (Kingston & Diehl 1994)

Voiceless (/p·t·k·s/..) < Voiced (/b·d·g·z/..)
Vowels

Articulatory phonetic theory

a) Vowel backness: when pronouncing back vowels, the oral cavity space in front of the tongue is larger than when pronouncing front vowels.

b) Vowel height: when pronouncing low vowels, the mouth is more wide open compared to when pronouncing high vowels.

Acoustic phonetic theory

a) Vowel backness is directly related to the frequency of the second formant (F2). 
   → F2 frequency is high in front vowels, and gets gradually lower going towards back vowels. Therefore, back vowels with low F2 should be associated with bigger referents than front vowels with high F2. (Ohala 1994)

b) Vowel height is directly related to the frequency of the first formant (F1). However, since the F1 frequency change is small across vowels, it is hard to make predictions regarding its effect on sound symbolism.

Relative opposition between categories:

a) Front vowels < Back vowels
   /i·e/></o·u/

b) High vowels < Low vowels
   /i·u/></e·o/></a/
Experiment 1 — Goals

Do Japanese speakers show the tendency to associate certain sounds to particular meanings?

If a sound symbolic pattern emerges, does it follow one of those predicted by the theories mentioned before? Or is it a new, different pattern?

If the observed pattern conforms to one of the predictions made by the two mentioned theories, can we establish which of the two is more valid by looking at the sound-symbolic effect of vowels?
Procedure

Survey: 50 undergraduate students at Fukuoka University (36 males and 14 females, mean age: 22 years)

40 non-word stimuli + 40 dummy non-words

Setting and instructions

- Let us assume that there is a particular language which contains a rich vocabulary of words to express fish names. Native speakers of this language differentiate the meaning of these words, which are listed in the following pages, based on the size of the fishes and that of their movements.
- Try to read each word in the following list while picturing in your mind the scene of fishes swimming underwater.
- Judging by how the pronunciation of each word sounds like, try to guess the size of the fish they refer to, and rate it in a scale from 1 to 6.

1-6 rating scale

- 1 → Very small
- 2 → Small
- 3 → A bit small
- 4 → A bit large
- 5 → Large
- 6 → Very large
Stimuli

- Non-words
- Open syllables
- 2-syllable repetition

\[ C_1 VC_2 V \rightleftharpoons C_1 VC_2 V \]

Vowels

<table>
<thead>
<tr>
<th>Voiceless consonants</th>
<th>Voiced consonants</th>
</tr>
</thead>
<tbody>
<tr>
<td>/p/</td>
<td>/t/</td>
</tr>
<tr>
<td>/i/</td>
<td>/pinipini/</td>
</tr>
<tr>
<td>/e/</td>
<td>/penepene/</td>
</tr>
<tr>
<td>/a/</td>
<td>/panapana/</td>
</tr>
<tr>
<td>/o/</td>
<td>/ponopono/</td>
</tr>
<tr>
<td>/u/</td>
<td>/punupunu/</td>
</tr>
</tbody>
</table>
Results: Consonants

Average ratings

Voiceless
Voiced

2.495
4.061
Results: Vowels

![Graph showing vowel results]
Discussion

Front

F2(Hz)

Back

2500
2000
1500
1000
500
200
300
400
500
600
700
800
500
1000
1500
2000
2500

High

Low

i

F1(Hz)

u

Front

Back

F2(Hz)

2012/11/15
Conclusion

Do Japanese speakers show a pattern which can be related to synesthetic sound symbolism?

Is this pattern predicted by one of the theories presented earlier?

By analyzing the sound-symbolic effect of vowels:

The acoustic phonetic theory is more valid.

Size-sound symbolism:
A process by which visual characteristics of external referents are correlated systematically to specific acoustic properties of sounds.
The vast majority of the experiments on sound-symbolism carried on up to now have been based on an explicit approach:

- Directly matching words and pictures, or words and meanings
- Evaluating words based on a given sound-meaning correlation
- …

Is sound-symbolism a process whose effects can only be observed when explicit decisions on some sound-meaning correlation are required? Or is it a deeper, more automatic process, whose effects can be observed also when no direct task about it is performed?
Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998):
Measures the degree of association between two concepts without the need for explicit questioning

**CONCEPT A (SIZE)**
- A1 (Big)
- A2 (Small)

**CONCEPT B (CONSONANT VOICING)**
- B1 (Voiced)
- B2 (Voiceless)

**PHASE 3:**

**PHASE 5:**
- A1/B2 – A2/B1

**MATCH (SAME HAND)**

**MISMATCH (DIFFERENT HAND)**
Stimuli

PART 1: Consonant voicing

- SIZE (BIG - SMALL)
  - Big fish pictures
  - Small fish pictures
  - Non-words with voiced consonants
  - Non-words with voiceless consonants

CONSONANT VOICING (VOICED - VOICELESS)

PART 2: Vowel backness

- SIZE (BIG - SMALL)
  - Big fish pictures
  - Small fish pictures
  - Non-words with /u/ vowel
  - Non-words with /i/ vowel

VOWEL BACKNESS (BACK V. - FRONT V.)

MATCH CONDITION:
- Big x voiced
- Small x voiceless

MISMATCH CONDITION:
- Big x voiceless
- Small x voiced

MATCH CONDITION:
- Big x u
- Small x i

MISMATCH CONDITION:
- Big x i
- Small x u
Results: PART 1 - Consonant voicing

![Graph showing mean reaction time for words and pictures with match and mismatch conditions.]
Results: PART 2 - Vowel backness

![Graph showing mean reaction times for words and pictures]

- Words:
  - Match: 618 ms
  - Mismatch: 807 ms

- Pictures:
  - Match: 594 ms
  - Mismatch: 743 ms
Conclusion

If there was no connection between the two concepts, there should be no difference in reaction times between match and mismatch conditions.

In both parts of the experiment reaction times for the match condition were significantly faster than those for the mismatch condition.

Sound-symbolic effects can be observed not only when explicit decisions on some sound-meaning association are required, but also when no direct task is performed. (Size)sound-symbolism: a process where visual and acoustic properties are automatically correlated to each other.
References


