When 'BAB' becomes 'DAD':
Development of Auditory-Visual Speech Perception in English-Speaking Children

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BACKGROUND

- Visual influence on speech perception varies across languages:
  - American-English > Japanese (Sekiyama & Tohkura, 1993)
  - Japanese > Mandarin (Sekiyama, 1997)
- Developmental evidence for auditory-visual speech perception (AVSP):
  - Infants perceive visual speech (Burnham & Dodd, 2003; Desjardins & Werker, 2003; Rosenblum et al., 1997).
  - Visual speech influence increases with age (McGurk & MacDonald, 1976)
- Developmental + cross-language (Sekiyama & Burnham, 2003):

Australian		Japanese
6-year-olds	=	6-year-olds
Λ		॥
8-year-olds	>	8-year-olds

RESEARCH QUESTION

What factors affect the increase in auditory-visual speech perception in English-speaking children between 6 and 8 years of age?

EXPERIMENT 1A: SCHOOL CHILDREN

METHOD

Participants

N=96; **5-yrs** (n=24), **6-yrs** (n=24), **7-yrs** (n=24), **8-yrs** (n=24)

Stimuli & Dependent Variables

AVSP:
- Auditory-only (AO)
- Visual-only (VO)
- Auditory-Visual (AV) →

AV Congruent (A/ba/-V/ba/, A/da/-V/da/, A/ga/-V/ga/)
AV Incongruent (A/ba/-V/ga/, A/da/-V/ba/, A/ga/-V/ba/)

Visual Speech Index (VSI) = [AV Congruent] – [AV Incongruent]

Language Specific Speech Perception (LSSP):
18 native ([pa] vs. [p^{h}a]) & 18 non-native ([ba] vs. [pa]) contrasts
LSSP Score = Native DI – Non-native DI

$$\text{Discrimination Index (DI)} = \frac{\text{Hits - False positives}}{\sum \text{Trials}}$$

Articulation: Queensland Articulation Test (QAT)
Initial, *medial* and *final* position consonants in 64 picture items
Articulation Score = Correct Responses / 64

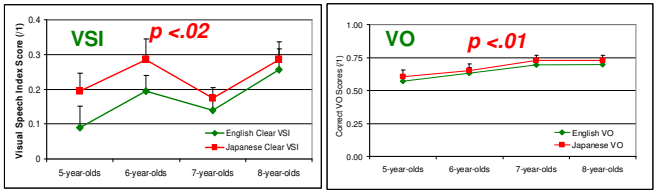
Reading: WRAT-3 reading subtest→15 letters + 42 words
Reading Score = Correct Responses / 57

EXPERIMENT 1A (Continued)

RESULTS (ANOVA)

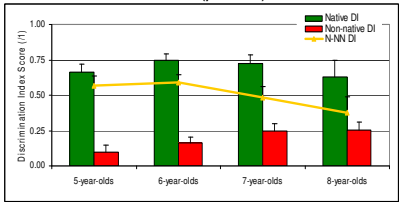
AVSP

- Increase in VSI clear (p <.02) and lipreading (VO) (p <.01)
- Greater visual speech influence for native AV stimuli (p <.05)
- Greater visual speech influence in noise (p <.01)



LSSP

- No age-based increase in DI scores (p >.05), *but* Native > Non-native: (p <.01)



Articulation & Reading

- Age-based increase in articulation (p<.01) *and* reading (p <.01)

REGRESSION ANALYSES

- Age + AO + **Lipreading (VO)** + **LSSP** + Reading + Articulation → **VSI**
- Age + AO + VSI + LSSP + Reading + Articulation → **Lipreading**

DISCUSSION

- **VO (lipreading) and LSSP predict AV speech.**
- **Use of visual speech is related to selective attention to native speech.**
- **Burnham (2003) found reading is related to selective attention to native speech sounds.**
- **Perhaps the high cognitive demands of exposure to new faces, accents, etc. at school is similar to high cognitive demands of reading, which necessitates the use of visual speech information.**

EXPERIMENT 1B: ADULTS

METHOD & RESULTS

- Same dependent variables as in Experiment 1A (*N*=48)
- Regression Analyses:
  - Age + AO + Lipreading (VO) + LSSP + Reading + Articulation → **VSI**
  - Age + AO + VSI + LSSP + Reading + Articulation → **Lipreading**

DISCUSSION

- **Only AO predicts VSI. Over age skills become 'automatic' and 'independent' of each other, hence they are not as strongly interlinked as in school years, which require tackling linguistic challenges.**

EXPERIMENT 2: PRESCHOOL CHILDREN

Participants

N=48; **3-yrs** (n=24), & **4-yrs** (n=24)

Stimuli & Dependent Variables

AVSP: McGurk stimuli, 3 conditions: AO, VO, & AV
Discrimination Task→ VSI$_{AX}$ score for AV items
e.g. A/ba/ + V/ga/ vs. A/ba/ + V/ba/ → 'different' response → Visual response

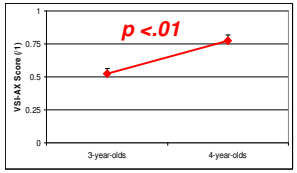
LSSP:
Same as Experiments 1A & 1B + Positive reinforcement for correct R's.
LSSP= (Native DI) – (Non-native DI)

Receptive Vocabulary Test: Peabody Picture Vocabulary Test (Dunn & Dunn, 1997).
Standard PPVT Score

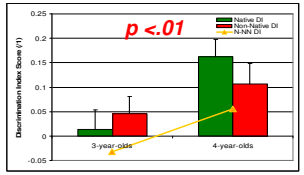
Executive Function Test: Flexible Item Selection Test (FIST)
2 scores: Rule Abstraction + Cognitive Flexibility (/30)

RESULTS (ANOVA)

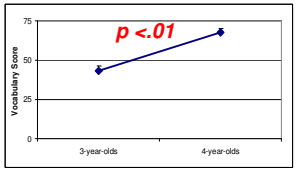
AVSP



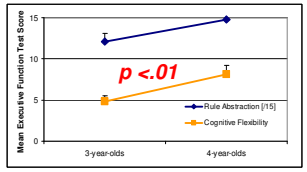
LSSP



Vocabulary



Executive Function



RESULTS (REGRESSION ANALYSES)

- Age + **AO** + VO + LSSP + Vocabulary + **FIST** → **VSI-AX**
- Age + AO + VSI-AX + LSSP + Vocabulary + **FIST (Rule)** → **VO**

DISCUSSION

- **Cognitive skills predict AVSP and lipreading.**
- **Auditory-only (not LSSP) predicts AVSP**
- **The challenge of vocabulary acquisition does not augment VSI.**

CONCLUSION

- **Visual speech information is used to meet linguistic challenges.**
- **In the early school years linguistic abilities LSSP, AVSP and lipreading are interconnected (Exp 1A).**
- **In the preschool years and adulthood, AVSP is best predicted by AO speech perception (Exps 1A & 2).**
- **There is AVSP in infancy and childhood. It appears that the linguistic challenge at school onset brings on a more phonemic language-specific AVSP over and above the phonetic AVSP in infancy.**