Friday 4 July 2008 – SC00/4 – Speech Communication IV
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The effect of learning on listening to ultra-fast speech

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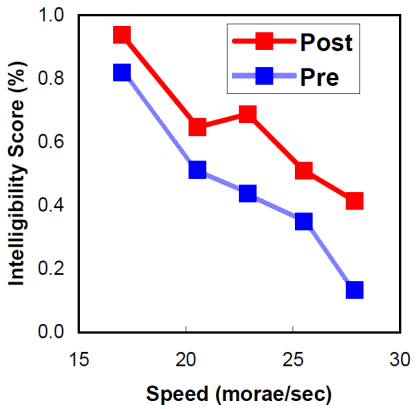
Objective

- Visually impaired persons
  - use PC with voice-enabling software
  - get information via synthesized voice
  - important to acquire information efficiently
  - **Ultra-fast speech** : they can practice
- This work : observe the learning effect
  - effect of word familiarity
  - intelligibility & mental workload
    - undesirable when mental workload increases

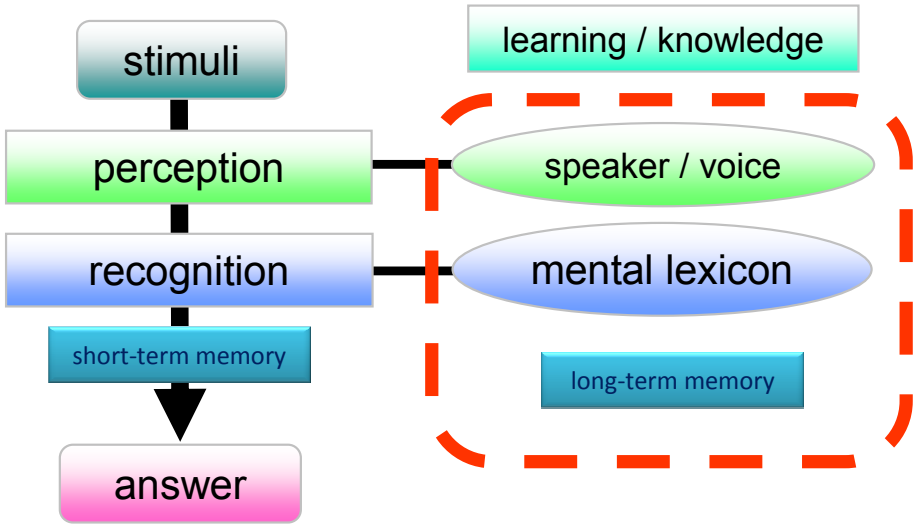
Prior work

- [Asakawa et. al. 2003, 2005]
  - fast speech by shortening the recorded human voices
  - by the skilled users of the screen reading software
  - The skilled listeners assessed
    - the appropriate speed as 19.5 morae/sec (recall 90%)
    - the ultimate speed as 25.0 morae/sec (recall 50%)
- [Nishimoto et. al. 2006, 2007]
  - TTS voices : 4-digit numbers (18-30 morae/sec)
  - experiments with young persons
    - significant learning effects
    - sustained for several weeks
  - age-related effects : intercept the learning
    - difficulty of recall digits in the correct order



Listening ultra-fast speech

- Bottom-up process
  - dominant when low-familiarity task
  - learning effect : less significant
  - mental workload : high
- Top-down process
  - lexicon is important
  - mental workload : low



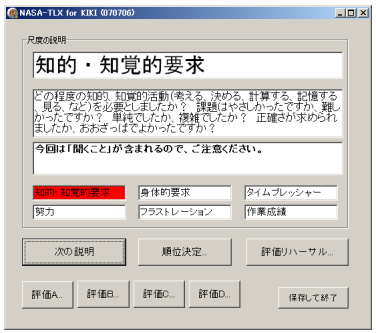
- Word familiarity
  - awareness influences the learning effect

Estimation of mental workload

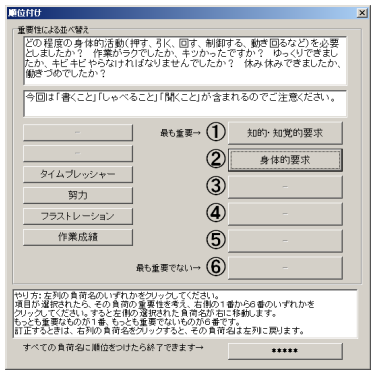
- NASA-TLX : weighted mean workload
  - Mental demand / Physical demand
  - Temporal pressure / Effort
  - Frustration level / Performance
    - easy to use, reliably sensitive

WWL score

explanation



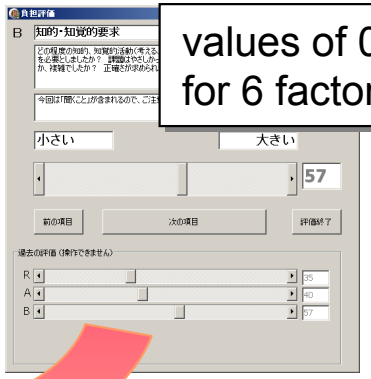
ranking



magnitude of factor (6-1)

listening
ultra-fast
speech

evaluation

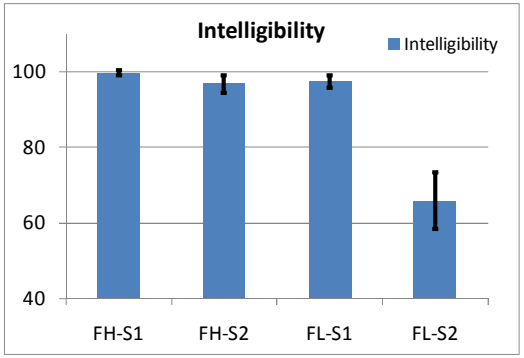


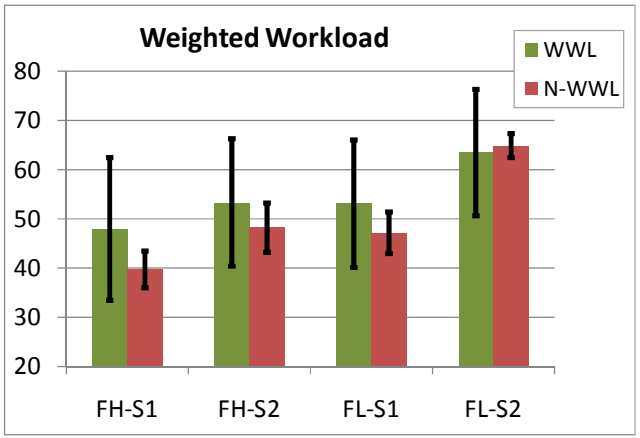
values of 0-100
for 6 factors

rest time (5min) before next task

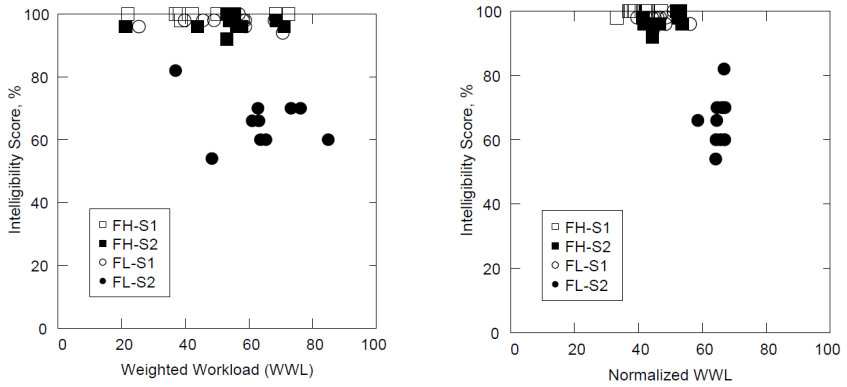
Preliminary experiment

- Results : significance in WWL & intelligibility
  - except the case between FH-S2 and FL-S1
    - speed : S1=original / S2=2.0 times faster
    - familiarity : FH / FL





WWL and intelligibility score of each subject (N=10)



Normalization of WWL

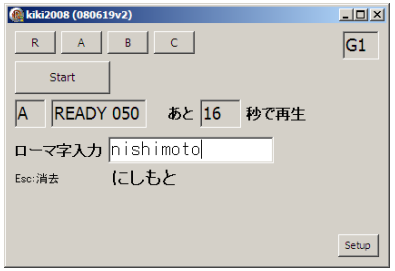
Transformed the ave. and SD of WWL
of each subject to 50 and 10, respectively

Familiarity controlled speech

- FW03 [Amano2006]
  - audio data set for word intelligibility test
    - based on Japanese word familiarity database
  - 4 levels of familiarity
    - 4 morae words : accent controlled
    - a group consists of 50 words : phoneme balanced
  - Recorded speech
    - speed controlled, loudness level calibrated
- Stimuli : audio speed conversion was used
  - 4 times faster = approx. 20 morae / sec
  - highest (H) / lowest (L) familiarity groups were used
- Evaluation : number of correct morae

Experiment

- Subjects (N=59) : divided into 4 groups
  - PC with headphones for everyone
  - Input roman characters with key-board
- Each trial consists of 50 words
  - 16 seconds interval
  - word familiarity was not informed



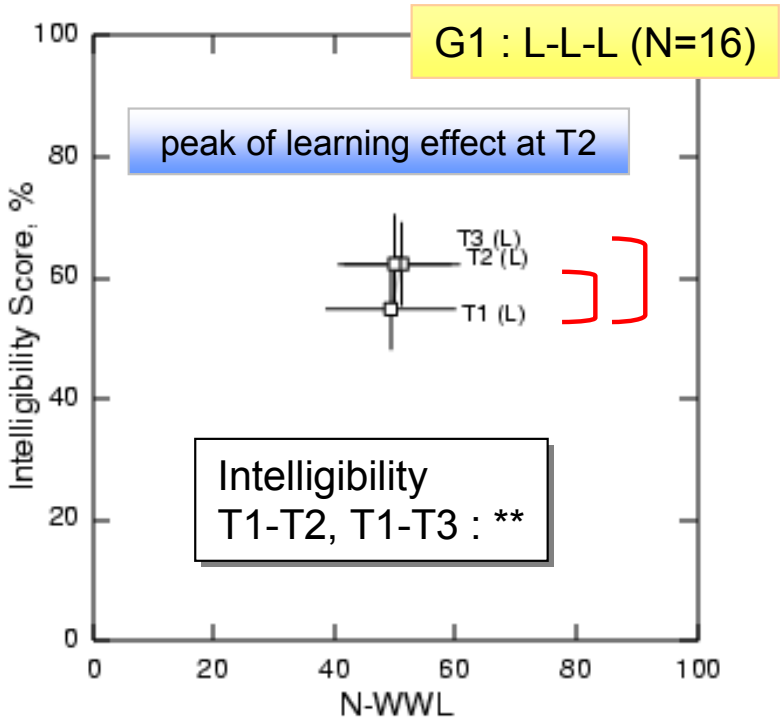
Group	Trial 1	Trial 2	Trial 3
G1 : L-L-L	FLS1	FLS2	FLS3
G2 : H-H-L	FHS1	FHS2	FLS3
G3 : L-L-H	FLS1	FLS2	FHS3
G4 : H-H-H	FHS1	FHS2	FHS3

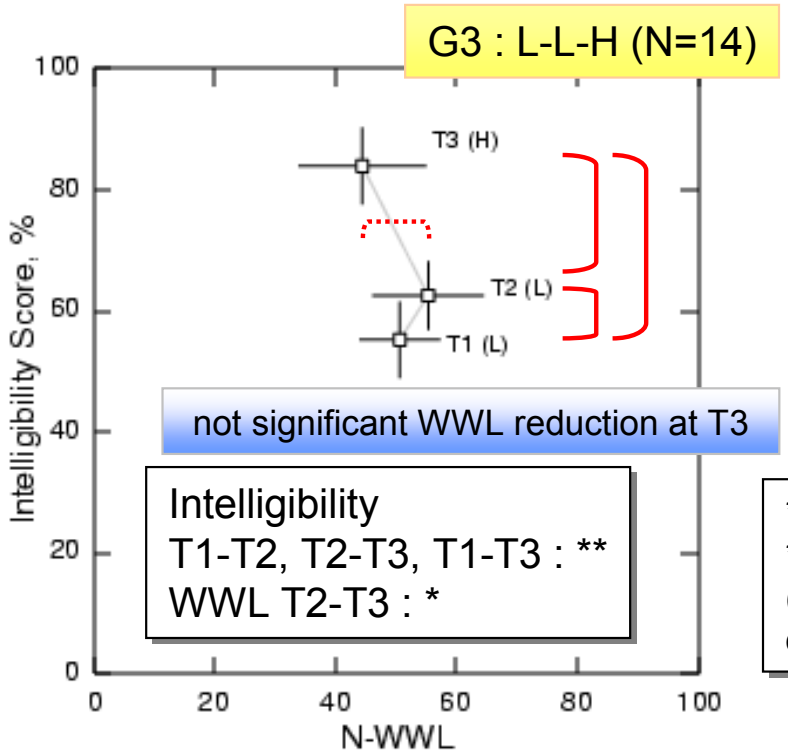
S1, S2, S3 : different vocabulary (same condition)

difficult to use mental lexicon

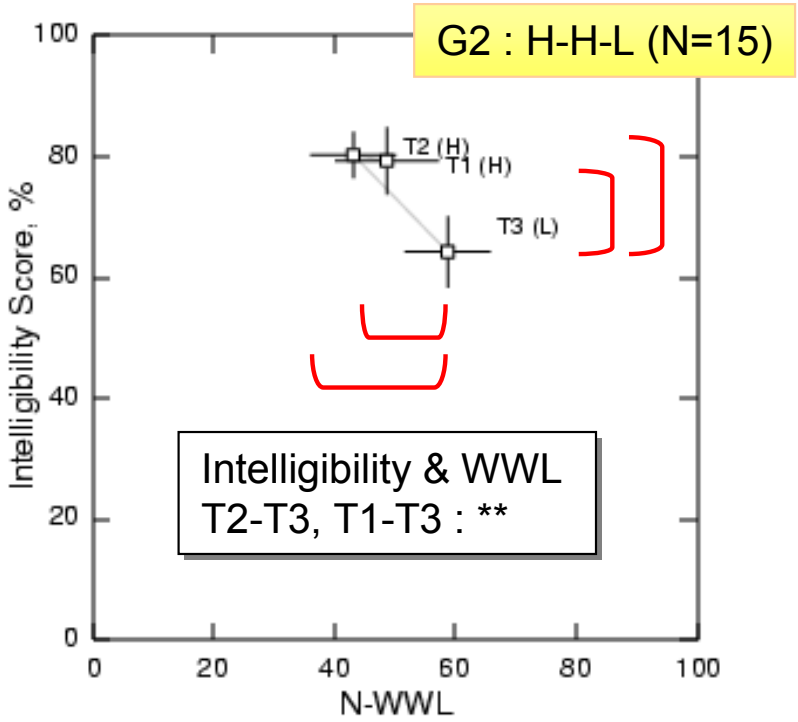
if they are not aware of the change, they do not use mental lexicon

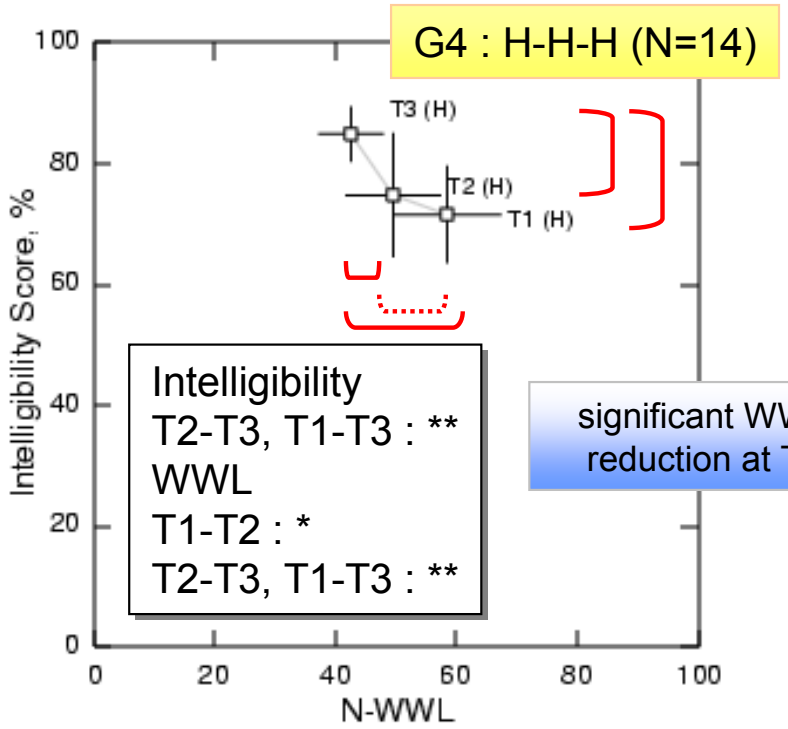
if they are aware of high familiarity, they can use mental lexicon





** : p < 0.05
* : 0.05 < p < 0.10
(t-test of two tailed distributions)



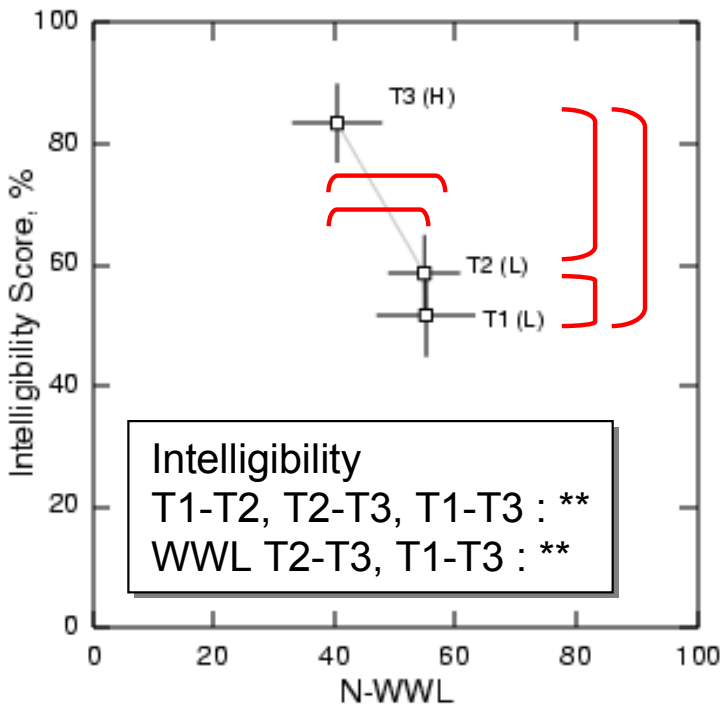


No significant differences between T3 of G1-G2 and T3 of G3-G4, respectively

Conclusion

- Learning reduces mental workload **if lexicon is used**
- Without using lexicon, learning effect is limited
- **Awareness is the key**
  - indications may change
- Future work:
  - longer period experiment
  - age-related effects
  - TTS applications

L-L-H
with indication of familiarity (N=7)



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