**RESEARCH QUESTIONS**

**RQ1.** Are individual differences in the sensitivity to and use of multiple acoustic cues for L1 categorization related to novel phonological contrast learning?

**RQ2.** Can additional training with L1 decrease the possible learning gap due to individual differences?

**BACKGROUND**

**Prediction 1:** Learners with more sensitivity to the secondary cue (f0) learn novel contrast better when the secondary cue is more informative in novel contrast.

- Multiple acoustic cues in the perception of speech contrast
  - English stop voicing contrasts: VOT (primary), f0 (secondary)
  - Korean three-way stop contrasts
    - Lenis vs. Aspirated: f0 (primary), VOT (secondary)
    - Fortis: shortest VOT, mid-to-high f0

- Wide range of individual differences in cue-weighting strategies
  - e.g. Some English listeners’ higher sensitivity to secondary cue observed by gradient response patterns on the VAS task [1, 2]

- Transfer of cue-weighting strategy from native to non-native language perception [3, 4].

**Prediction 2:** Additional training, expected to adapt native cue-weighting strategy in favor of L2 contrast, can aid impaired learners (i.e. reallocation of attention to more informative cue before learning L2 contrast).

- Perceptual adaptation to unfamiliar L1 & L2 speech by adjusting cue-weighting strategies (i.e. reweighting of secondary cue) [4, 5]

- Manipulation in training stimuli (e.g. stimuli variance, feedback) may effectively down-weight the uninformative dimension and up-weight the informative dimension [6, 7].

**METHODS**

**Experiment 1**

**Participants**
- 14 L1 English speakers without Korean learning experience
- Secondary cue-sensitivity in English stop contrast categorization
  - Stimuli: total 35 pseudo-synthetic CV stimuli constructing a continuum from English /d a/ to /ta/ varying in 7 steps of VOT and 5 steps of f0
  - Task: Visual Analogue Scaling (VAS) task

**Experiment 2**

- New 14 L1 English speakers were assigned to either Categorical 1 or Gradient 1 group.
- Same procedure as Experiment 1 except Additional training

**Additional training (Inhibition training)**
- Provided before each daily familiarization phase
- Stimuli: same English stimuli used for the VAS task but only with two extreme f0 values were presented.
- Feedback: the answers of each stimulus for feedback were determined only by f0 values.
- Task: 2AFC (“Is this English /ba/ or /pa/?”)

**RESULTS & DISCUSSION**

**Coefficients of VAS histograms:**

- Gradient groups < Categorical groups (p < .01)
- RQ1: Individual differences observed in the VAS task are reflected in the learning of non-native contrast.
  - Gradient 1 who showed more sensitivity to f0 outperformed the Categorical 1 in both everyday ID and two generalization tests.

**Figure 1:** Results of the AXB pre-test, posttest, and new consonant generalization tests in percentage correct (% left) and results of everyday ID tests (Day 1, Day 2, & Day 3) and new talker generalization test (right).

**Figure 2:** Native Korean listeners’ patterns in the target stimulus identification test (top) and mapping plots of responses of the tests after the first and third training sessions by one participant each from the Categorical group (left) and the Gradient group (right).

**Figure 3:** Results of the AXB pre-test, posttest, and new consonant generalization tests in percentage correct (% left) and results of everyday ID tests (Day 1, Day 2, & Day 3) and new talker generalization test (right).

**Figure 4:** Mapping plots of responses of the tests after the first and third training sessions by one participant each from the Categorical group (left) and the Gradient group (right).

**Discussion:**

- Importance of considering individual differences in designing training paradigms to maximize learning outcomes while minimizing training time span
- Addition of perceptual adaptation period requiring noncanonical use of acoustic cues results in nativelike perceptual pattern in L2 regardless of initial naive cue-weighting strategies.

**REFERENCES**