

# **Adaptive Psychophysical Methods** *(cont.)*

# Outline

- **Simple Up-Down Method (also known as Staircase Method)**
- **Transformed Up-Down Methods**
  - ◆ **Overview**
  - ◆ **The 3-interval 1-up 3-down Method**
- **Interleaved Adaptive Methods**
  - ◆ **Double-Random Staircase (i.e., interleaved simple up-down method)**
  - ◆ **Interleaved 3I 1-up 3-down method**

# The Three-Interval One-Up Three-Down Method

- There are three stimulus presentations per trial
  - ◆ Two of the intervals contain the reference stimulus
  - ◆ One randomly-selected interval contains the test stimulus
  - ◆ Subject's task is to indicate which interval (1, 2 or 3) contains the signal that is *different*
- The level of the reference is kept constant
- The difference between the test and reference is increased after one incorrect response
- The difference is decreased after three successive correct responses
- This method is both efficient and robust (see Leek, 2001)
- The threshold corresponds to the 79.4%-percentile point on the psychometric function. *Why?*

# Demo of 3-I 1-up 3-down Method

- Go to course website:  
<http://shay.ecn.purdue.edu/~ece511/>
- Click on “Online Experiments”
- Scroll down to “Part III. Adaptive Methods”
- Select the third bullet “Line-Length Discrimination (3IFC)”
- Run yourself

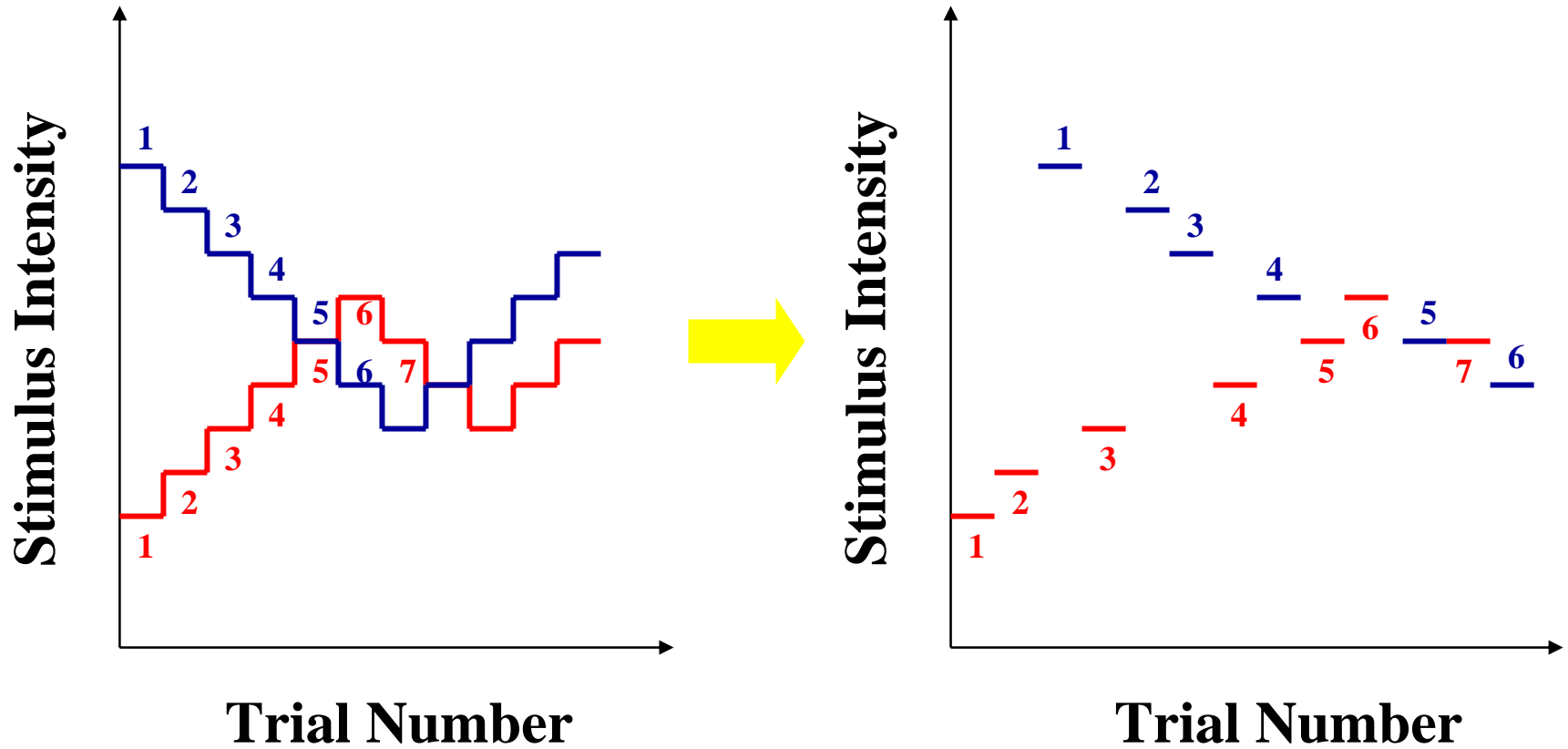
# Interleaved Adaptive Methods

- **To eliminate the response bias that is inherently present in the staircase method, the experimenter interleaves two or more staircase sequences by randomly assigning trial numbers to the sequences. As a result, the subject can no longer reliably keep track of the direction (increase or decrease) along which stimulus intensity will vary.**

# Double-Random Staircase

- This is an example of interleaving two simple up-down sequences.
- One of the sequences is an *ascending* one, and the other *descending*.
- On each trial, one of the two sequences is randomly selected by a computer program.
- The stimulus level is based on the subject's previous responses to trials belong to the selected sequence only.
- The experiment ends when both sequences have been completed.

# The Idea



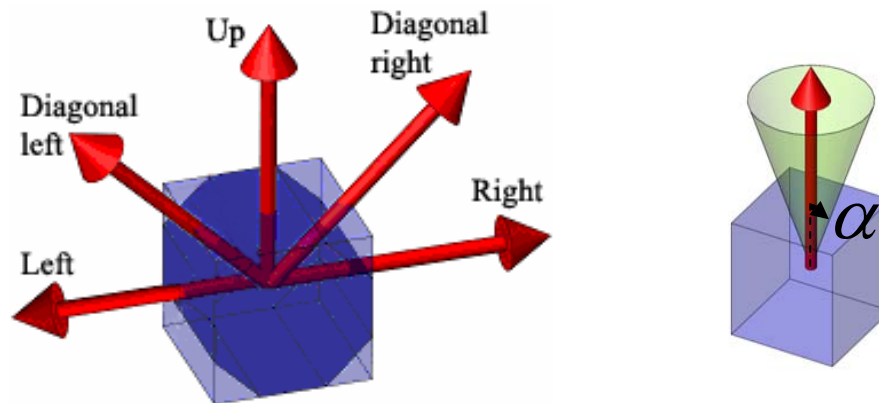
# **Interleaved 3I 1-Up 3-Down Method:** *Force-Direction Discrimination*

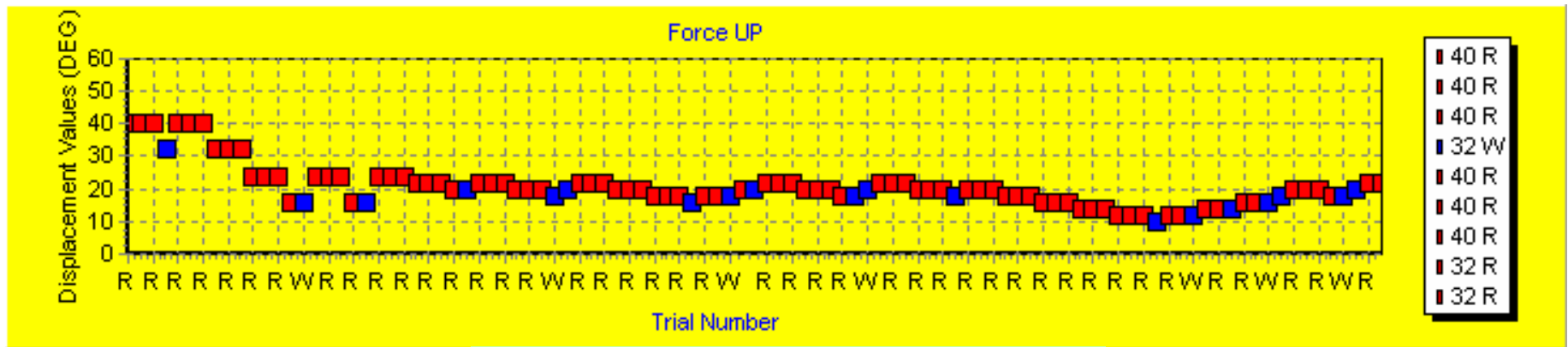
- **In this example, five (5) conditions corresponding to five reference-force directions were interleaved. On each trial, one of the conditions is selected with equal probability (0.2).**
- **This method also equalizes/eliminates *training effects* for the multiple conditions.**



# Method

- Independent variable  $\alpha$  is the angle between  $F_{\text{ref}}$  and  $F_{\text{test}}$
- The participants' task was to indicate the odd force direction from amongst three forces ( $F_{\text{ref}}$  twice,  $F_{\text{test}}$  once, in randomized order) presented in each trial





( Threshold =  $18.8^{\circ} \pm 1.9^{\circ}$  )

- Initial  $\Delta\alpha$  (difference in direction between  $F_{\text{ref}}$  and  $F_{\text{test}}$ ) was  $8^{\circ}$ , for quick *convergence*
- $\Delta\alpha$  was reduced to  $2^{\circ}$  after the first five reversals, for better *accuracy*
- The sequence was terminated after 12 reversals at  $2^{\circ}$
- Threshold is computed as the average of the peaks & valleys at the last 12 reversals

# References

- Levitt, H. (1971). Transformed up-down methods in psychoacoustics. *Journal of the Acoustical Society of America*, 49(2), 467-477.