Just Noticeable Differences (JND)

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What is JND?

JND determines how accurate human sense are. As Weber's law first suggested, JND is the minimum level of stimulation that a person can detect 50 percent of the time

Examples:

- Increase in volume of a television set
- dimming of light
- Technological Applications

sensation

Senses

Main focus

Perception

Objectives of JND

This experimental method is used in Psychophysical evaluations - to determine human perception and physical stimuli.




How to Conduct JND

The 'JND' is a fixed proportion of the initial sensory level, and so JND is a constant proportion/percentage of the reference level. Measured in———— physical units.

using weber's law,

$$\frac{\Delta I}{I} = k,$$

In order for a change to be perceived in a medium, 2 stimuli must differ by a constant proportion.

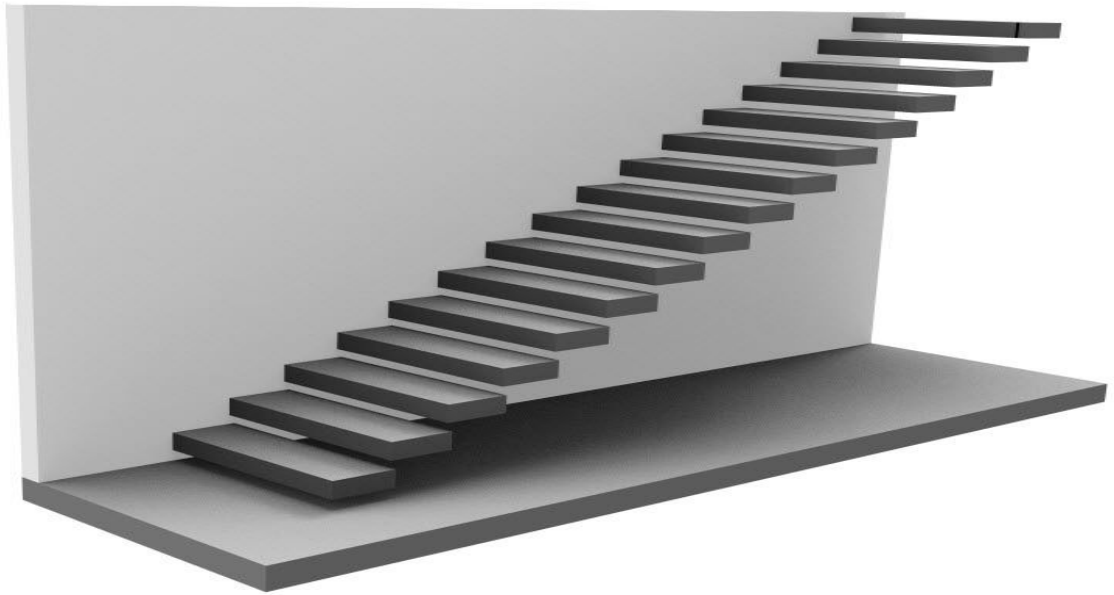
delta I - difference from stimulus

I - original intensity of stimuli

k - weber's constant

METHOD

Staircase method - variation of stimuli in ascending or descending order.



source - https://www.keuka-studios.com/types-of-stairs-2/

The High Performance Stylus System (HPSS)

Stimuli to be measured	Target Latency	Verification Method
Latency of HPSS	min of 1ms with an increment of 2ms display of 200 dpi was needed	high speed camera used. stroke velocity and the gap distance was obtained from the footage to calculate latency

USER STUDIES

latency response gathered through observational experiment of a target focus group (16 naive individuals).

Tasks

1. Large box dragging
2. Small box dragging
3. Scribbling

Baseline for dragging : 1ms

Baseline for scribbling: 7ms

staircase method used for each task - to maintain comparability

results

2 separate analysis for dragging and scribbling - difference in baseline

Dragging

1. participants were able to discriminate between latencies with the smaller box (2-16ms) than the larger one (2-7ms)

Scribbling

1. users were able to discriminate between the 7ms baseline and a median of around 40ms

result - task may play a role in latency perception

Visual JND

Stimuli to be measured	Target	Verification Method
minimal level of pixel variation unit used - JND point	Achieve a higher resolution that can be noticeable	dataset over range of QP obtained (880 videos) Machine learning used to predict JND values in short time four resolutions obtained (1920 × 1080, 1280 × 720, 960 × 540,and 640 ×360)

- QP of videos in dataset ranged from 1 to 51

USER STUDIES

more than 30 participants in the subjective testing, unreliable participants were removed based on statistical procedures.

each participants compared a sequence of 2 video clips to determine if its different or not (1080p and 720p)

Result

Half the participants noticed some changed but difficult to use the results.

Test inconclusive.

Was due to discrimination and anticipation error

BENEFIT of JND

JND is more suitable than other metrics to evaluate human subjective perception

DRAWBACKS of JND

1. Discrimination - seeking to determine at what point there is a difference between two stimulus
2. conclusion of experimentation depends on other factors
3. anticipation error - premature judgement
4. response bias - people tend to say ***yes*** most often
5. difficult to conclude with this experimental procedure

SOURCES

1. Kendra Cherry, April 2020, https://www.verywellmind.com/what-is-the-just-noticeable-difference-2795306, [accessed 23/10/2021]
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3. In the Blink of an Eye: Investigating Latency (Perception during Stylus Interaction); *Albert Ng, Michelle Annett, Paul Dietz, Anoop Gupta, and Walter F. Bischof*

The End

THANK YOU