



# Influence of near and far spaces in categorization of lengths and numerosities

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## Background

1. Perception mechanisms of numbers, space, time, and other magnitudes could be deeply linked. (Buetti & Walsh, 2009)
2. Neuroimaging studies show that different brain areas are involved in bisection and pointing task for near VS far space (Weiss et al., 2000)
3. In a physical lines and number pairs bisection task, a rightward shift is observed proportionately to the distance between the subject and the stimulus. (Longo & Lourenco, 2006)

## Research Questions

1. Will the distance of the stimulus location influence participant's categorization?
2. Will the same effects be present in the two magnitudes?

## Hypotheses

We expect to find in both lengths and numerosities

- Over-categorization in far space
- Under-categorization in near space

## Methods

### Participants:

- \* 20 students from Louvain-la-Neuve University (8 males).

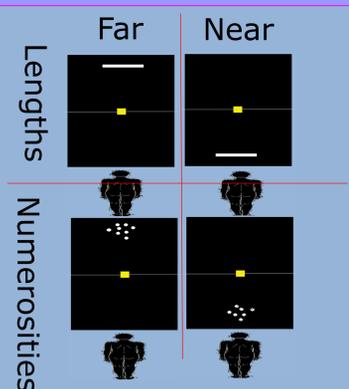
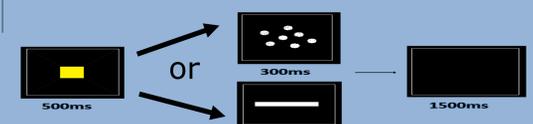
### Stimuli:

- \* Stimuli projected on a table (260 x 120cm)
- \* 13 lengths/numerosities : 8-12-16-20-24-28-32-36-40-44-48-52-56 dots/cm
- \* Little stimuli = 8-12-16 dots/cm Big stimuli = 48-52-56 dots/cm
- \* Lengths represented by rectangles
- \* Numerosities represented by dot collections
- \* Two kind of dots collection :
  1. Intensive = size of dots and empty space stay constant
  2. Extensive = Luminance stays constant
- \* Sequential numerosities were represented by dots flashed one by one
- \* Subjects have to respond « short » or « large » with a four buttons box

### Tasks:

- \* Exposition: 18 short items/18 large items
- \* Training: categorization of 12 short items/12 large items + Feedback
- \* Experience: categorization of 2 x 156 controlled stimuli
- \* Stimuli were presented at 42cm from the subject for near space condition
- \* Stimuli were presented at 142cm from the subject for far space condition

### Presentation time of one item



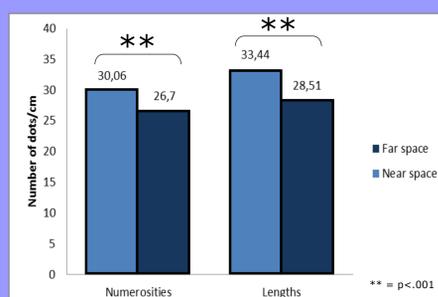
## Results

### Bisection points

= Moment where the responses of the subject is 50% large and 50% small (When  $y=50$ ) (Droit - Volet, 2008)

### Lengths and Numerosities

The results show more accuracy for the near condition and a nonsignificant under-categorization. In the far condition a significant over-categorization is shown.



### Sequential numerosities

There are no significant results in this condition

## Conclusion

- Similar results were obtained in the lengths and numerosities conditions.
- The findings demonstrate that these two magnitudes are perceived in the same way and could thus involve the same cognitive process.
- The non-significant results of the sequential numerosities show that surface area could help the categorization in the numerosities with dot collections

Buetti, D., & Walsh, V. (2009). The parietal cortex and the representation of time, space, number and other magnitudes.

Droit-Volet, S., Clément, A., & Fayol, M. (2008). Time, number and length: similarities and differences in discrimination in adults and children.

Longo, M. R., & Lourenco, S. F. (2010). Bisecting the mental number line in near and far space. *Brain and Cognition*, 72(3), 362-7. <http://doi.org/10.1016/j.bandc.2009.10.016>

Weiss, P. H., Marshall, J. C., Wunderlich, G., Tellmann, L., Halligan, P. W., Freund, H. J., ... Fink, G. R. (2000). Neural consequences of acting in near versus far space: a physiological basis for clinical dissociations. *Brain: A Journal of Neurology*, 123 Pt 12, 2531-2541. <http://doi.org/10.1093/brain/123.12.2531>