Effects of visual illusions on grasping: The Parallel-Lines Illusion

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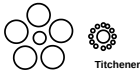
1. Introduction

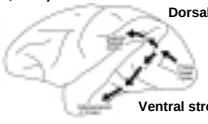
- Aglioti, DeSouza, & Goodale (1995) reported that grasping is not (or only marginally) affected by the Titchener / Ebbinghaus Illusion.



Titchener / Ebbinghaus Illusion

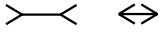
- This was interpreted as evidence for the existence of two cortical visual system: A dorsal stream that enables action and a ventral stream that enables perception (Goodale & Milner, 1995).

Dorsal stream: Action



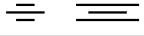
Ventral stream: Perception

- To the contrary, we have shown that the Titchener Illusion *does* influence grasping - and that there is an almost perfect match between the effects on grasping and on perception (ECVP 1998; Franz et al., 2000). We also provided evidence for a mismatch between the perceptual task and the grasping task in the study of Aglioti, DeSouza & Goodale (1995) which can account for the smaller effect of the Titchener Illusion on grasping in this study.
- Similarly, we found that the Müller-Lyer Illusion affects grasping and the effect on grasping was even somewhat larger than on perception (ARVO 1999).



Müller-Lyer Illusion

- Here, we tested whether the Parallel-Lines Illusion affects grasping.

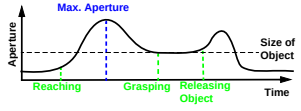


Parallel-Lines Illusion

2. Dependent Variables

Grasping

Maximum Preshape Aperture:



- The maximum preshape aperture is linearly related to object size and therefore a measure for size-information in the motor system.
- The grasp trajectory was recorded using an Optotrak™ system.

Perception

Matching of length in an adjustment task. In Exp. 3 also a magnitude estimation task was used.

References

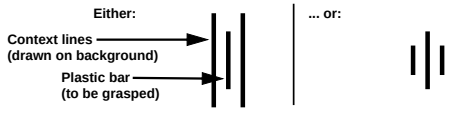
Aglioti S., DeSouza J.F.X., & Goodale M.A. (1995). Size-contrast illusions deceive the eye but not the hand. Current Biology, 5(6), 679-685.

Franz, V. H., Gegenfurtner, K. R., Bülthoff, H. H., & Fahle, M. (2000). Grasping visual illusions: No evidence for a dissociation between perception and action. Psychological Science, 11(1), 20-25.

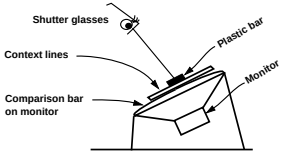
Jordan, K. & Schiano, D. J. (1986). Serial processing and the Parallel-Lines illusion: Length contrast through relative spatial separation of contours. Perception and Psychophysics, 40(6), 384-390.

3. Exp. 1: Grasping the Illusion.

- Stimuli:
  Plastic bars: 40, 43, 46, 49 mm long, 7 mm wide, 5 mm in height.

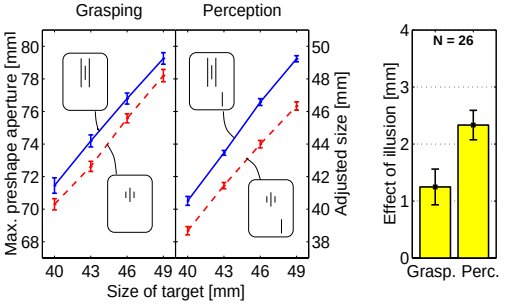


- Apparatus:



- Procedure:
  - Grasping task: The participants grasped the plastic bar. Vision of hand and stimuli was suppressed as soon as the hand started moving.
  - Perceptual task: A comparison bar was presented on the monitor. The participants adjusted the length of the comparison bar to match the length of the plastic bar.

Results

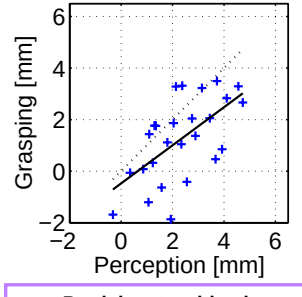


ANOVA - Factor	p	
Grasp-Illusion	< .001	**

ANOVA - Factor	p	
Perceptual-Illusion	< .001	**

t-Test	p	
Task	< .001	**

Grasping is affected by the Parallel-Lines Illusion! The grasping illusion, however, is smaller than the perceptual illusion.



Individual illusion effects

(each data point corresponds to one participant).

Correlation: .61 (p<.001)

Participants with a large perceptual illusion also show a large grasping illusion!

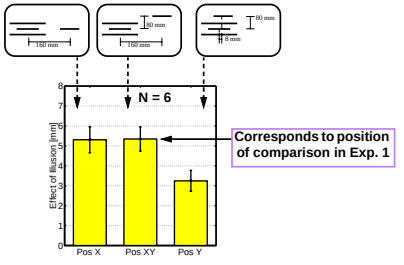
4. Control-experiments

- The Parallel-Lines Illusion is the first illusion for which we found a smaller effect on grasping than on perception.
- Does this result indicate that the action system is only marginally affected by the Parallel-Lines Illusion (as was proposed by Aglioti, DeSouza & Goodale, 1995) - and therefore contradict our previous studies?
- We do not think so, because:
  -Participants with a large perceptual effect also showed a large grasping effect (across-participants correlation). This suggests that both illusions are generated by the same neuronal source.
  -It could be that the grasping task and the perceptual task were not adequately matched - causing a difference in the size of the illusion effects. This was tested in the following control experiments.

5. Exp. 2: Position of comparison

It was tested whether the position of the comparison bar relative to the illusion context affects the size of the perceptual illusion. Because no grasping was involved in this experiment, all stimuli were presented on a computer monitor.

Results



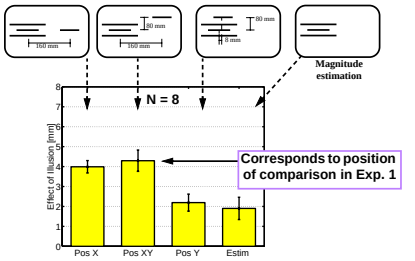
The position of the comparison bar has a large influence on the size of the perceptual illusion.

Because grasping does not involve a comparison bar it is unclear which position should be used in the perceptual task.

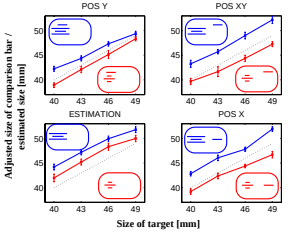
6. Exp. 3: Magnitude Estimation

- Experiment 2 shows that the position of the comparison bar strongly affects the size of the measured perceptual illusion.
- Because in grasping there is no comparison bar involved, the question arises which position of the comparison bar should be used to be compared to grasping.
- We replicated Experiment 2 and added a magnitude estimation task as a perceptual measure which does not involve a comparison bar: Participants were first trained to estimate the length of bars in Millimeters, and then estimated the length of the target bar in the Parallel-Lines Illusion.

Results



The results in more detail...:



Magnitude estimation shows a small illusion (similar to the POS Y condition and to grasping).

- These results suggests that the large perceptual illusion in the POS X condition and in the POS XY condition was caused by the large distance between the target bar and the comparison bar in these conditions.
- Jordan & Schiano (1986) also found that the Parallel-Lines Illusion depends on distance: With small distances the Parallel-Lines Illusion excerts an assimilation effect (a long line causes a short line to be perceived longer). With large distances the effect reverts to a contrast effect (a long line causes a short line to be perceived as being even shorter).
- Applying this finding to the comparison bar can explain our results: A large distance between the illusion context and the comparison bar induces a contrast effect. This effect is opposite to the effect on the target bar - and hence leads to a larger measured illusion:

7. Conclusions

- The Parallel-Lines Illusion affects grasping.
- The across-participants correlation between perceptual effect and motor effect suggests that the same neuronal source is responsible for the generation of the perceptual illusion and of the motor illusion.
- The fact that the Parallel-Lines Illusion affected perception more than grasping in Experiment 1 could be due to a contrast effect of the illusion context on the comparison bar. This contrast effect can not affect grasping because grasping does not involve a comparison bar.