

DOES VISUAL SPACE CORRESPOND TO IMPLIED IMAGE SPACE?

INTRODUCTION

Visual space has a non-linear structure (Koenenkink, van Doorn, & Todd, 2009; Koenenkink, J., Van Doorn, A., & Lapin, J., J., 2000) that is reflected in artistic depictions of observed and imaginary space (Burleigh, Pepperell & Ruta, 2018; Pepperell & Haertel, 2014; Matther, 2015). Recent studies showed that the same neuronal pathways are activated during mental imagery and perceptual tasks, providing empirical evidence for the link between visual imagination and perception (Kosslyn et al., 2001; Palmiero et al., 2019). We therefore hypothesised that imagined visual space corresponds to the non-linear structure of observed visual space.

DRAWING FROM IMAGINATION
Imagine looking at... (Experiment 1)

AIM: We tested whether participants represented ‘imagining looking at’ a target object in specific spatial locations (centre vs right vs left) as bigger compared to other two identical peripheral objects.

PARTICIPANTS: Twenty-two participants from Cardiff Metropolitan University student population (77.5% females; average age: 29 years; range age: 18-44 years) took part to the experiment.

PROCEDURE: The drawing task consisted of the following steps:
1) to close their eyes and ‘imagine three oranges, aligned along the same horizontal line’;
2) then to ‘imagine looking directly at the central (right or left) orange more than the other two’;
3) and finally to open their eyes and to draw what they imagined. Each participant produced three drawings in total (see Figure 1), with the target orange being respectively the central, the left or the right one in each task.

RESULTS DRAWING TASK

We used Rstudio (RStudio Team, 2015) and lme (Pinheiro et al., 2018) to perform a linear mixed effects analysis on the drawn areas of the target orange, divided by the ratings obtained by the images falling under the other two intensity categories, respectively: ‘same’ and ‘smaller’ for size, ‘equal’ and ‘closer’ for position.

There was a significant main effect of looking instructions, \( \chi(2)=26.36, p<0.001 \), meaning that the area of the target orange was significantly bigger than the other drawn oranges, \( b=2.81, t(133)=5.377, p<0.001 \), with a small effect, \( r=0.27 \). No significant main effect of object position (\( p>0.5 \)) and no significant interaction with looking instructions (\( p>0.05 \)) were found. The results are illustrated in Figure 2.

CONCLUSIONS

In this study we investigated the correspondence between visual and imagined visual space. We found that when asked to ‘imagine looking at’ a target object in a specific spatial location, participants drew it significantly bigger compared to the other objects in the periphery (Experiment 1). When asked to ‘imagine paying attention’ to a target figure, we found a similar pattern of results: size variations represented significantly more accurately what participants visualized in their imagination compared to when position was manipulated (Experiment 2). This study is in line with previous findings (Burleigh, Pepperell & Ruta, 2018; Pepperell & Haertel, 2014, Mather, 2015) and confirmed the critical role of enlarged object size in imagined visual space and its intrinsic link with the phenomenology of visual perception.

REFERENCES


MENTAL IMAGES USING SEMANTIC OR VISUAL INPUTS
Imagine paying attention to... (Experiment 2)

AIM: We investigated properties of visual mental images, focusing on the way participants ‘imagined paying attention’ to the central figure surrounded by two other identical ones, and comparing two experimental conditions which provided respectively semantic descriptions and visual support.

PARTICIPANTS: Sixty-six participants (63% females; average age=37.2 years; age range=19-51 years), gave informed consent to take part in the study and were recruited via the Prolific platform (www.prolific.ac).

PROCEDURE: FIRST SESSION: SEMANTIC TASK

Participants were asked to ‘imagine three human figures in front of you, next to each other. Now imagine you are paying attention to the central figure more than the other two’ and then to answer two forced-choice questions about how they visualized the position and size of the central object compared to the other two. They could choose between three levels of intensity (more, equal, and less) for the position and the central object.

SECOND SESSION: VISUAL TASK

The instructions were the same as in the first session, but this time participants were given a visual stimulus as a reference to create the mental image, consisting of a single human figure. We controlled for the intensity of both relative size (bigger, same: smaller) and position (closer, equal, further away) of the central object creating a set of stimuli, as illustrated by Figure 4. Participants were asked to rate on a 5-points Likert scale how accurately each image represented what they imagined.

For an example of the online procedure, please scan the code below.

RESULTS VISUAL TASK

An Accuracy ratio was calculated, representing the proportion of ratings for the images falling under the ‘bigger’ and ‘closer’ intensity categories divided by the ratings obtained by the images falling under the other two intensity categories, respectively: ‘same’ and ‘smaller’ for size, ‘equal’ and ‘further away’ for position.

We used Rstudio (RStudio Team, 2015) and lme (Pinheiro et al., 2018) to perform a linear mixed effects analysis on the Accuracy ratios to investigate the relationship between stimuli manipulation (position and size) and intensity. We included as random effect the intercept for participants’ identity.

There was a significant main effect of stimuli manipulation, \( \chi(9)=187.8, p<0.001 \), meaning that the position manipulation had a significantly smaller effect compared to size, \( b=0.028, t(139)=3.9, p<0.001 \), with a small effect, \( r=0.22 \). A significant main effect of intensity, \( \chi(9)=187.8, p<0.001 \), meaning that the more/same ratio was significantly smaller compared to the more/less ratio, \( b=-0.47, \( \chi(9)=16.5, p<0.001 \), with a big effect size, \( r=0.7 \). No significant interaction (\( p>0.05 \)) was found. The results are illustrated in Figure 5.

RESULTS SEMANTIC TASK

As expected, ‘equal’ was the modal category for position, while ‘bigger’ for size (Figure 3). A Chi-square test was performed only on the frequencies for more (‘bigger’ or ‘closer’) and less (‘same’ or ‘equal’) intensity categories. Figura’s property (position and size) and intensity showed a significant association, \( \chi(3)=11.4, p=0.005 \). A pairwise post hoc analysis with a Bonferroni correction revealed that there was a significant difference between the percentages associated with the two intensity categories (\( p>0.05 \)), meaning that participants were more likely to imagine the central human figure as having the same position, but being significantly bigger compared to the other two. The results are illustrated in Figure 3.

CONCLUSIONS

In this study we investigated the correspondence between visual and imagined visual space. We found that when asked to ‘imagine looking at’ a target object in a specific spatial location, participants drew it significantly bigger compared to the other objects in the periphery (Experiment 1). When asked to ‘imagine paying attention’ to a target figure, we found a similar pattern of results: size variations represented significantly more accurately what participants visualized in their imagination compared to when position was manipulated (Experiment 2). This study is in line with previous findings (Burleigh, Pepperell & Ruta, 2018; Pepperell & Haertel, 2014, Mather, 2015) and confirmed the critical role of enlarged object size in imagined visual space and its intrinsic link with the phenomenology of visual perception.

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