THE INVOLVEMENT OF THE SUPERIOR COLLICULI IN HEMISPHERECTOMIZED SUBJECTS WITH BLINDSIGHT

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Introduction

Blindsight:

--> Ability to respond to visual stimuli in the blind field without consciously experiencing them (Ref. 1)
--> Neuronal basis of blindsight still unknown (Fig. 1)
--> Most prominent hypothesis postulates the involvement of the superior colliculi (SC)

We demonstrate using a computer-based reaction-time test that blindsight in hemispherectomized subjects (HSs) can only be measured for achromatic and not for s-cone stimuli.

Since primate data have shown that the SC lack s-cone sensitive neurons, our results are consistent for s-cone stimuli. (HSs) can only be measured for achromatic and not test that blindsight in hemispherectomized subjects in involvement of the superior colliculi (SC) without consciously experiencing them (Ref. 1)

Blindsight:

250 ms

Visual Pathway in Hemispherectomized Subjects

Retina

Contralateral pulvinar (input from color-opponent cells)

Ipsilateral Superior colliculus (no s-cone input)

Visual cortical areas

Hemispherectomized Brain

Figure 1: Visual Pathway in Hemispherectomized Subjects

Methods

Subjects

--> 16 control subjects
--> 5 HSs (Table 1, Fig. 3) were classified into a ‘with blindsight’ (subject DR, SE, UF) and ‘without blindsight’ group (subject FD, JB) according to their performance in previous studies carried out in our labs (Refs. 2,3)

Stimuli:

1. Achromatic (SC-visible, Pulvinar-visible) gabor patches
2. Blue/yellow (SC-insensitive, Pulvinar-visible) gabor patches

Presentation of stimuli:

--> Detection threshold x 10
--> At 10° to the right, left, or in both visual fields (Fig. 2)
--> Onset-time randomized at 0/500/1000ms with an inter-stimulus interval of 2000ms

Reaction time test using a Spatial Summation Effect paradigm (SSE, reaction times to two bilaterally presented stimuli are significantly faster compared to a single one)

Either achromatic or blue/yellow stimuli were displayed on a calibrated CRT monitor to isolate the two pathways (Ref. 4).

Fixation was monitored with an eye tracking system.

Results

Figure 2: Stimulation paradigm

Degrees of stimulus presentation:

250 ms

ITI = 2 sec

UL (+10°)

UF (+10°)

BL (+10°)

UL = Unilateral Left

UR = Unilateral Right

BL = Bilateral

Stimulus type:

black/white & blue/yellow gabor patches

Table 1: Participating hemispherectomized subjects

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sex</th>
<th>Ethnicity</th>
<th>Kinology Type</th>
<th>Diagnosis</th>
<th>Age at surgery</th>
<th>Age</th>
<th>Sex</th>
<th>Blindsight</th>
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<tr>
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<td>Right homonymous cortex</td>
<td>Partial hemispherectomy</td>
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<td>17</td>
<td>L</td>
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<td>African-American</td>
<td>Left homonymous cortex</td>
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<td>18 &amp; 26</td>
<td>L</td>
<td>61</td>
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<tr>
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<td>Hispanic</td>
<td>Right homonymous cortex</td>
<td>Functional hemispherectomy</td>
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<td>18 &amp; 20</td>
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<td>19</td>
<td>R</td>
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</tbody>
</table>

Possible artefacts and explanations ruled out:

--> Accurate fixation ensured with an eye tracking system
--> Light scatter minimized with:

1. low contrasts
2. gabor stimuli: no overall change in mean-luminance
3. no SSE in HS without blindsight

--> Chromatic detection thresholds established and visibility equalized amongst conditions

--> No Spared islands of occipital cortex

--> Direct geniculo-extrastriate-koniocellular projection ruled out

--> Direct retino-pulvinar-cortical connection ruled out

Conclusions

Spatial Summation Effect present in control subjects and hemispherectomized subjects with blindsight

SSE present for s-cone and achromatic stimuli in normal subjects

SSE only present for achromatic stimuli in hemispherectomized subjects with blindsight

Blindsight, at least in hemispherectomized subjects is color-blind to blue/yellow stimuli

Pulvinar receives input from color-opponent ganglion cells: Probably not through a direct retinal connection.

Blindsight likely mediated by the Superior colliculus

References


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