THE INVOLVEMENT OF THE SUPERIOR COLLICULI IN HEMISPHERECTOMIZED SUBJECTS WITH BLINDSIGHT

Sandra E. Leh[1], Kathy T. Mullen[2], and Alain Ptito[1];
[1]Montreal Neurological Institute & Hospital, [2]Vision Research Department of Ophthalmology; McGill University, Montreal, Canada

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 with the hypothesis that blindsight is mediated through a collicular color-blind pathway.

Figure 1:
Visual Pathway in Hemispherectomized Subjects

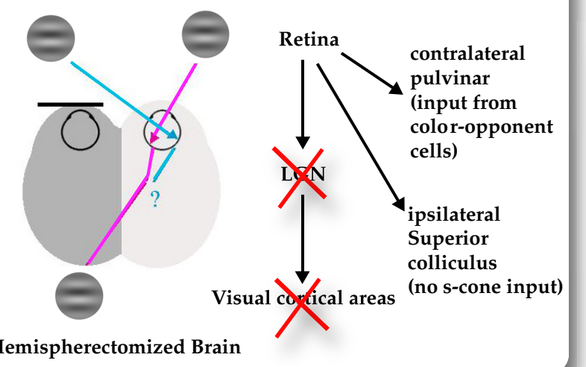
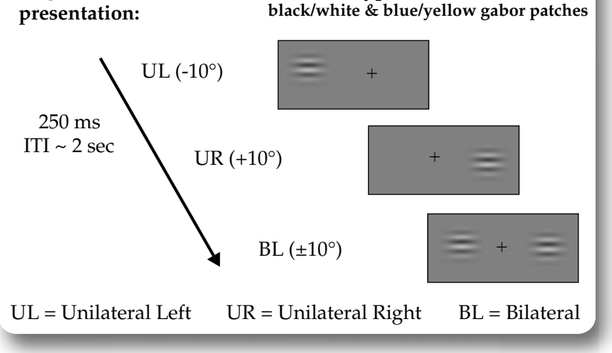


Figure 2: Stimulation paradigm



Methods

- Subjects
  - --> **16 control subjects**
  - --> **5 HSs (Table 1, Fig. 3)**: were classified into a '**with blindsight**' (subject DR, SE, LF) 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-invisible, Pulvinar-visible) **gabor patches** (1cpd, spatial σ=1cycle, temporal σ =250ms)
- **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.

Figure 3: HSs Subject

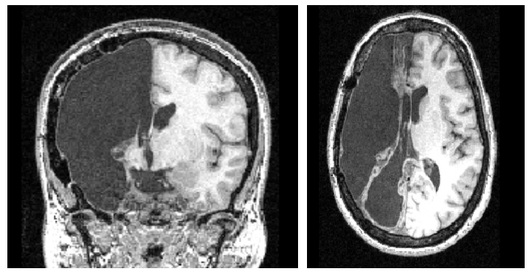
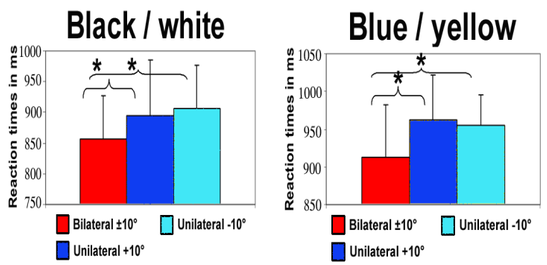


Table 1: Participating hemispherectomized subjects

Subject	Sex	Etiology	Surgery Type	Seizure onset	Age at surgery	Side	Age	Blindsight
SE	Male	Right porencephalic cyst	Partial hemispherectomy	7	25	R	40	Yes
DR	Female	Rasmussen 's Encephalitis	Functional hemispherectomy	5	17	R	31	Yes
LF	Male	Arterio - venous malformation	Functional hemispherectomy	23	19 & 26	R	41	Yes
JB	Male	Left porencephalic cyst	Functional hemispherectomy	5	18 & 20	L	40	No
FD	Female	Meningitis, right middle cerebral artery infarct	Functional hemispherectomy	1	18	R	23	No

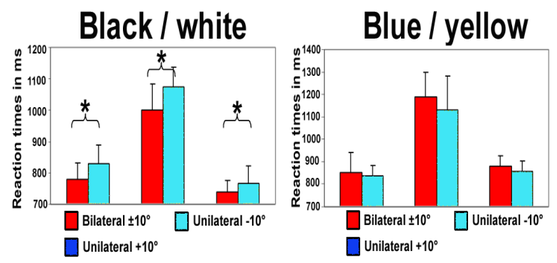
Results

Figure 5: Normal Controls (N=16)



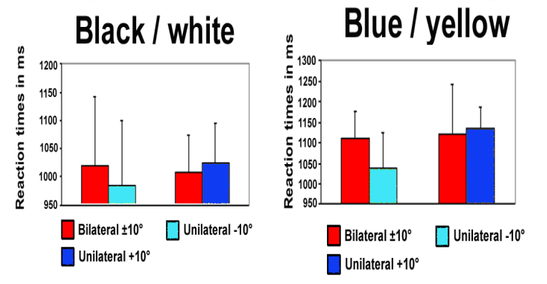
=> **Significant SSE for achromatic and blue/yellow stimuli**

Figure 6:
Hemispherectomized subjects with blindsight



=> **Significant SSE for achromatic but not for blue/yellow stimuli**

Figure 7:
Hemispherectomized subjects without blindsight



=> **No SSE for either stimuli**

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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