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1 Spatial attention and central crowding in primary open angle glaucoma

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20

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ABSTRACT

33 **Clinical relevance:** Measuring the impact of spatial attention on signal detection in damaged
34 parts of the visual field can be a useful tool for clinicians in ophthalmology.

35 **Background:** Studies on letter perception have shown that glaucoma exacerbates difficulties
36 to detect a target within flankers (crowding) in parafoveal vision. A target can be missed
37 because it is not seen or because attention was not focused at that location. This prospective
38 study evaluates the contribution of spatial pre-cueing on target detection.

39 **Method:** 15 patients and 15 age-matched controls were presented with letters displayed for
40 200ms. Participants were asked to identify the orientation of the target letter T in two
41 conditions: an isolated letter (uncrowded condition) and a letter with two flankers (crowded
42 condition). The spacing between target and flankers was manipulated. The stimuli were
43 randomly displayed at the fovea and at the parafovea at 5° left or right of fixation. A spatial
44 cue preceded the stimuli in 50% of the trials. When present, the cue always signaled the
45 correct location of the target.

46 **Results:** Pre-cueing the spatial location of the target significantly improved performance for
47 both foveal and parafoveal presentations in patients but not in controls who were at ceiling
48 level. Unlike controls, patients exhibited an effect of crowding at the fovea with a higher
49 accuracy for the isolated target than for the target flanked by two letters with no spacing
50 between the elements.

51 **Conclusion:** Higher susceptibility to central crowding supports data showing abnormal foveal
52 vision in glaucoma. Exogenous orienting of attention facilitates perception in parts of the
53 visual field with reduced sensitivity.

54

55

56 **Keywords:** glaucoma, spatial attention, crowding

57

58 INTRODUCTION

59 Glaucoma is an ocular pathology characterized by progressive retinal ganglion cell
60 loss associated with visual field defect. The classical view of vision deficit in glaucoma is a
61 visual field defect that is initially restricted to the periphery with minimal impact on central
62 vision. However, studies using optical coherence tomography (OCT) have reported
63 abnormalities in the macula, the central part of the visual field, at all stages of the disease.¹
64 Furthermore, evidence from experimental studies shows that some patients with glaucoma
65 exhibit deficits in central vision-dependent activities such as reading and face recognition.²⁻⁹
66 Slower reading and deficits in face recognition have been accounted for by impaired eye
67 movements and/or reduced contrast sensitivity.^{4, 6, 7, 10} Other explanations have emerged more
68 recently. It has been suggested that reading difficulties in glaucoma might result from an
69 increase in receptive field size, which may in turn exacerbate a crowding effect in parafoveal
70 vision.³ Visual crowding refers to the deterioration of performance when the feature to be
71 recognized (letter, object...) is near other stimuli.¹¹ In line with this account, Shamsi et al.¹²
72 reported that the critical spacing between target and flanker letters to escape crowding was
73 larger in patients with glaucoma than in normally sighted age-matched controls in parafoveal
74 vision. However, higher susceptibility to crowding in glaucoma does not seem to be limited to
75 parafoveal vision. Stievenard et al.¹³ investigated susceptibility to crowding in foveal vision
76 in glaucoma with faces as stimuli. They showed that patients were better at recognizing a
77 facial feature (the mouth) in isolation (uncrowded condition) than within the context of a face
78 (crowded condition), whilst age-matched controls exhibited a better performance in the
79 “mouth within a face” condition.

80 In addition to reduced contrast sensitivity, and possibly a higher susceptibility to central
81 crowding, Phu et al.¹⁴ demonstrated that another factor can modulate performance in
82 glaucoma. They investigated the extent to which minimized spatial uncertainty, through
83 attentional cueing, affects contrast sensitivity. In their study, contrast sensitivity was
84 measured at two different eccentricities (9.5° and 17.5°) and with two sizes of spotlights:
85 Goldmann sizes III (0.43° in diameter) and V (1.72° in diameter). In each trial, the number
86 and location of the stimuli was verbally cued to the participants. The results showed that
87 reducing uncertainty through verbal cueing improved sensitivity at locations with severe
88 visual field defects. Phu et al. used endogenous cueing in which attention is voluntary
89 oriented to certain regions of the visual field through verbal instructions. A transient
90 exogenous spatial cueing was used in the present study. Exogenous attention is more

91 automatic than endogenous attention. It reflects situations in which attention is automatically
92 captured by a change in color, luminance or motion in the visual field. Studies in young
93 individuals have demonstrated that spatial pre-cueing, via an exogenous transient cue,
94 enhances spatial resolution at the attended location.¹⁵⁻¹⁶ For instance, Yeshurun and Rashal¹⁷
95 found that the critical spacing between letters to escape crowding was shorter when attention
96 was oriented towards the spatial location of the letters via a pre-cue. The purpose of the
97 present study was to determine whether transient spatial pre-cueing enhances perceptual
98 performance in patients with glaucoma, and especially, whether target detection in a crowded
99 condition is facilitated when a cue indicates the spatial location of the stimulus.

100

101 **METHOD**

102

103 **Participants**

104

105 Fifteen patients with a visual field defect due to primary open-angle glaucoma
106 participated, ranging from 40 to 81 years of age (mean age 64.6 years). Each patient
107 underwent a complete ophthalmological examination including a visual field evaluation just
108 before the experiment. As central vision was tested, visual field sensitivity (expressed as the
109 Mean Deviation) was measured with a central 10-2 strategy on the Humphrey Field Analyzer
110 SITA Standard (HFA II, Carl Zeiss Medical, CA, USA). The visual fields were classified
111 according to HPA classification.¹⁸ Visual acuity and contrast sensitivity were measured using
112 the Freiburg Vision Test.

113 Fifteen age-matched controls ranging from 53 to 78 years of age (mean age: 64.5
114 years) were recruited among the patients' relatives and the staff of the department of
115 ophthalmology. Inclusion criteria for both patients and controls were the following: no history
116 of neurological and/or psychiatric disease, no ocular disease other than glaucoma for patients,
117 and no family history of glaucoma for controls. Cataract was an exclusion criterion. Age-
118 matched controls received an ophthalmological examination prior to inclusion to rule out any
119 sign of glaucoma. All controls had a normal intra-ocular pressure, no anomaly of the optic
120 nerve at the fundus examination, a normal visual field and a normal OCT. All participants
121 were asked to come with their usual optical correction. Patients and controls were tested
122 monocularly. Controls were tested on their preferred eye. For patients with bilateral
123 glaucoma, the tested eye was the one that met the inclusion criteria: **a significant deficit in the**

124 **mean deviation** on the 10-2 visual field test and an acuity equal to or better than 0.1 logMar. If
125 both eyes were impaired at the 10-2, the better eye was chosen.

126 The study was approved by the ethics committee for behavioral sciences of the
127 University of Lille. In accordance with the tenets of the Declaration of Helsinki, written
128 informed consent was obtained from all participants.

129

130 **Stimuli and apparatus**

131

132 The stimuli were uppercase letters, in Arial font, presented on a 15-inch DELL
133 computer screen. The target was the letter T, either oriented upright or inverted. The flankers
134 were the letter H positioned left and right of the target. The angular size of the letters was 0.4°
135 in height and 0.3° in width, at a viewing distance of 57 cm with the head fixed by a chin rest.
136 The stimuli were displayed in black (2.8 cd/m²) on a light gray (113 cd/m²) background.
137 Based on Yeshurun and Rashal study ¹⁷ a high contrast large cue was used : a yellow line
138 segment (200 cd/m²) covering 0.5° of visual angle and appearing 0.5° above the stimuli.

139

140 **Procedure**

141

142 The participants were tested in a dimly illuminated room with light coming from the edges
143 of venetian blind of the window. The lighting of the room was measured at 60 Lux
144 (Lightmeter Multimatrix LM76, Chauvin Arnoux, France). Each trial started with a black
145 central fixation cross (0.5°) displayed for 500ms. After a 500 ms blank gap, a yellow line
146 segment cue was displayed for 50 ms randomly in 50% of the trials. When present, the cue
147 always indicated the correct target location. The stimuli were displayed for 200 ms randomly
148 at three possible spatial locations (central 0° , at 5° left, at 5° right of fixation center to center)
149 immediately after the cue. The paradigm is illustrated in Figure 1. There was no control of
150 fixation as the fixation cross disappeared for 500ms before the presentation of the stimulus to
151 avoid forward masking of a central stimulus by the fixation cross. The fixation cross also
152 disappeared for 500ms before the presentation of parafoveal stimuli to avoid the fixation
153 marker serving as a cue that the stimulus would appear in the parafoveal field.

154 Crowding was assessed by manipulating the spacing between target and flankers and
155 by comparing performance between the crowded conditions and a baseline uncrowded

156 condition (an isolated T). In the crowded conditions, the target letter T was flanked by 2 Hs.
157 There were three spacings between target and flankers at 5° eccentricity. According to
158 Bouma's law, the critical spacing for identification of small letters is roughly half the
159 eccentricity.¹¹ The three chosen spacings were 2° (below the critical spacing), 2.5° and 3°
160 edge-to-edge. For central stimuli, the spacings between target and flankers were 0 (no
161 spacing) and 0.3° (corresponding to the width of a capital letter).

162 The target letter T, either isolated or flanked, was randomly presented upright in 50%
163 of the trials and inverted in the other 50%. Participants were asked to decide whether the letter
164 T was upright or inverted regardless of the presence of flankers. The response was given
165 using the arrow keys of the computer's keyboard (pointing top for upright and bottom for
166 inverted). The inter-trial interval was set at 1500ms after response.

167 The spacing conditions (three at 5° left, 3 at 5° right of fixation and two for central
168 stimuli + the isolated target), the cue (present/absent), the spatial locations of the stimuli and
169 the orientation of the T were randomly presented. The experimental session was composed of
170 440 trials determined by 120 central trials (isolated T and 2 spacing conditions X 2 cueing
171 conditions X 20 repetitions) and 320 parafoveal trials (isolated T and 3 spacing conditions X 2
172 cueing conditions X 2 spatial locations X 20 repetitions). The 20 repetitions were 10 upright
173 Ts and 10 inverted Ts. A pause was proposed after 110, 220 and 330 trials. Participants
174 resumed the experiment by pressing the space bar of the keyboard. The adaptation to the
175 ambient luminance varied between 5-7 minutes. It was followed by a training session of 20
176 trials to familiarize the participants with the exposure time of the letters, the experimental
177 session lasted 20-25 minutes depending on the response time and pauses of participants.

178

179 **[Figure 1 about here]**

180

181 **STATISTICAL ANALYSIS**

182

183 As the number of spacing conditions was different for parafoveal and central
184 presentations, separate ANOVAs were performed. As the percentage of correct responses is
185 not linear accuracy was converted to a Z-score for each group. Analyses were carried out
186 using Systat 8 software (Systat Software, Inc. San Jose, California). Although the upright T
187 was detected more accurately than the inverted T the orientation of the T was not included as
188 factor in the analysis since the advantage for the upright T was observed in both groups. Due
189 to large inter-individual variability (500 to 3000 ms) response times were not analysed. The

190 group was the between-subject factor. The spatial location of the stimuli, the presence of the
191 cue and the spacing between target and flankers were the within-subject factors. The relations
192 between clinical data (contrast sensitivity, visual field defect), age and amplitude of crowding
193 were assessed in the patient group using a Spearman correlation analysis. The relations
194 between clinical data and the benefit induced by spatial cueing, computed as accuracy for the
195 cued condition minus accuracy for the uncued condition were also tested.

196

197 **RESULTS**

198 The 10-2 visual fields of patients are displayed in Figure. The characteristics of the
199 two populations are summarized in Table 1. Patients and age-matched controls did not differ
200 significantly in age ($T(28) = 0.019$, $p = 0.98$) but contrast sensitivity was significantly lower
201 in patients than in controls (1.63 vs. 1.78; $T(28) = 2.25$, $p = .032$).

202 **[Figure 2 and Table 1 about here]**

203 **Central presentation**

204 On average, accuracy was higher in controls than in patients (by 13.5% $F(1, 28) =$
205 12.12 , $p = .002$).

206 ***Spatial attention***

207 The effect of pre-cueing was not statistically significant ($F(1, 28) = 0.7$, $p = 0.41$) but
208 group interacted significantly with cueing ($F(1, 28) = 4.4$, $p = .05$). As can be seen in Figure
209 3A, the benefit of pre-cueing resulted from the patient's group ($F(1, 14) = 9.7$, $p = .008$) and
210 more specifically for the isolated T ($T(14) = 2.75$, $p < .016$) and for the large spacing (0.3° :
211 $T(14) = 4.11$, $p < .006$). The effect of cueing was not significant in the control group ($F(1, 14)$
212 $= 1.85$, $p = 0.19$).

213 ***Crowding***

214 There was no main effect of crowding ($F(2, 56) = 1.56$, $p = 0.21$) but crowding
215 interacted significantly with group ($F(2, 56) = 6.48$, $p = .003$). The effect of crowding mainly
216 resulted from the patient's group ($F(2, 28) = 11.58$, $p = .001$). In patients, accuracy was higher
217 in the uncrowded condition (isolated T) than in both crowded conditions (spacing 0.3° : $T(14)$
218 $= 2.42$, $p = .02$ and no spacing: $T(14) = 4.01$, $p = .001$). There was no significant effect of
219 crowding in age-matched controls ($F(1, 14) = 3.06$, $p = .063$). The effect of crowding was

220 found in both cued and uncued conditions in patients (see Figure 3A). There was no
221 significant interaction between cueing and crowding.

222 The magnitude of crowding in each participant is presented in Figure 4 and averaged
223 over cue and no cue. Figure 4 shows that 12/15 patients exhibited a better performance with
224 the isolated T than in the crowded conditions. P2 was at ceiling level in both crowded and
225 uncrowded conditions and P11 and P15 did not exhibit an advantage in the uncrowded
226 condition.

227 [Figures 3A and 3B about here]

228

229 **Parafoveal presentation**

230 No significant main effect of spatial location of the target was observed (left 88.8% vs.
231 right: 84.8% $F(1, 28) = 1.33, p = 0.25$), nor was there any significant interaction involving this
232 variable. Results are presented in Figure 3B, averaged over spatial location. On average,
233 accuracy was higher in controls than in patients (93.6% vs. 80.1% $F(1, 28) = 11.09, p = .002$).

234 ***Spatial attention***

235 The main effect of cueing was not significant ($F(1, 28) < 1$) and cueing did not interact
236 significantly with group ($F(2, 28) = 1.52, p = 0.22$). However, Figure 3B shows that cueing
237 improved performance in patients ($T(14) = 8.89, p < .010$). The benefit of cueing was
238 significant for the small spacing ($2^\circ: T(14) = 2.84, p < 0.13$) and the large spacing ($3^\circ: T(14) =$
239 $2.17, p < .047$ but not for the intermediate spacing $2.5^\circ (T(14) = 1.5, p = 0.16)$. There was also
240 a significant benefit of cueing for controls only at the larger spacing ($3^\circ: T(14) = 2.5, p < .023$).

241 On average the benefit of parafoveal cueing was larger (cueing advantage: 9.68%) in
242 patients with a visual field defect at a severe stage (MD: -18 to -23) than in patients with a
243 visual field defect at an early or moderate stage (MD: -2 to -12) (cueing advantage 5.79%)
244 according to the HPA classification.¹⁸ The difference in cueing benefit for the two subgroups
245 (moderate/severe visual field defect) was significant ($F(1, 13) = 5.66, p < .033$).

246 ***Crowding***

247 No main effect of spacing was observed ($F(3, 84) = 0.32, p < 0.81$). Although
248 performance was better with the isolated T than in the crowded conditions in the patients'

249 group (see Figure 3B), no significant effect of spacing was observed in this group ($F(3, 42) =$
250 $0.99, p = 0.40$) or in the control group ($F(3, 42) = 0.69, p = 0.46$). There was no significant
251 interaction between cueing and spacing between elements.

252 [Figure 4]

253 **Correlations**

254 In the patient group the relations between the magnitude of crowding (defined as the
255 percentage of correct responses with the isolated T minus the percentage of correct responses
256 with the crowded T in the no spacing condition for central presentation) and age, contrast
257 sensitivity, acuity and mean deviation were tested. No significant correlations were observed
258 between the magnitude of crowding and age ($R = .161, p = .564$), visual acuity ($R = .247, p =$
259 $.374$), contrast sensitivity ($R = -.250, p = .368$) and mean deviation ($R = .0614, p = .828$). No
260 significant correlation was found in central presentations between the benefit of cueing and
261 contrast sensitivity ($R = .220, p = .429$), visual acuity ($R = .0362, p = .898$) and mean
262 deviation ($R = .802, p = .776$), or in parafoveal presentations between the benefit of cueing
263 and contrast sensitivity ($R = .182, p = .517$), visual acuity ($R = .189, p = .498$) and mean
264 deviation ($R = .066, p = .814$).

265 **DISCUSSION**

266 As spatial attention is one of the most important mechanisms for selecting relevant
267 information and reacting automatically to salient peripheral signals it is important to
268 investigate how it modulates perception in people with visual field defect. Numerous
269 psychophysical studies on young and older healthy individuals have shown that directing
270 attention to a spatial location, via a peripheral pre-cue, improves perceptual performance in
271 terms of accuracy, response times, contrast sensitivity and discriminability at that location.¹⁵⁻
272 ¹⁷ Attention exogenously captured by a salient signal affects early stages of processing by
273 reducing external noise and boosting the gain of the neuronal responses to visual stimuli.¹⁹⁻²⁰
274 In the present study, visual pre-cueing improved spatial resolution and facilitated target
275 discrimination in glaucomatous patients in both foveal and parafoveal vision. Pre-cueing did
276 not affect the performance of age-matched controls whose performance was at ceiling level
277 for both foveal and parafoveal presentations suggesting that the task was too easy for
278 normally sighted participants. A significant benefit of cueing was observed at the largest
279 spacing in parafoveal vision in controls likely because increasing spacing increased

280 eccentricity. Consistent with Phu et al.¹⁴ the benefit of cueing in parafoveal vision was
281 greater in patients with a severe visual field defect than in patients at an early or moderate
282 stage according to the HPA classification. Patients with cortical blindness are also known to
283 benefit from spatial attention in their blind hemifield. For instance, with a predictive central
284 cue Pedersini et al.²¹ found significantly faster reaction times in valid trials (i.e., when the cue
285 indicates the correct location of the target) in the sighted hemifield but also in the blind
286 hemifield of patients with cortical blindness, despite a lack of awareness in this region.

287 In foveal presentations, the proximity of flankers deteriorated performance compared
288 to the isolated target and to target and flankers with a larger spacing. This crowding effect was
289 observed in patients only. The lack of effect of crowding in central vision was expected in
290 controls, as sensitivity to visual crowding is usually observed in regions with lower spatial
291 resolution (i.e., in peripheral vision) in normally sighted individuals¹² whilst little crowding is
292 reported in normal central/parafoveal vision.²²⁻²³ The crowding effect in foveal vision in
293 patients is consistent with previous results with faces as stimuli.¹³ It is also consistent with
294 Kwon et al.³ Although they did not test the effect of crowding directly as they did not
295 manipulate the spacing between letters and there was no uncrowded condition, they found that
296 accuracy in reporting letters in central vision was lower in glaucoma patients than in controls.
297 Shamsy et al.¹² reported that glaucomatous damage is associated with increased crowding in
298 the parafoveal region (4°) relative to age-similar normal controls. No effect of crowding was
299 observed in parafoveal presentations in the present study although the tendency was present in
300 patients with a better performance for the isolated T (see Figure 3B). The better eye of
301 patients was tested in the present study whilst Shamsy et al.¹² observed significantly larger
302 crowding in the eye with more severe glaucomatous damage compared with the better eye.

303 Although the differences were not statistically significant due to high inter-individual
304 variability in patients, accuracy tended to be higher with the isolated T and with the large
305 target-to-flanker distance than with the smaller target-to-flanker distances in the cueing
306 condition in the parafoveal visual field. This result is consistent with Yeshurun and Rashal¹⁷
307 who showed that transient attentional cueing reduces the effect of crowding.

308 No significant correlation between the magnitude of the crowding effect and clinical
309 variables (contrast sensitivity and visual field defect) was observed likely because contrast
310 sensitivity and visual field are measured at contrast threshold whilst the letters were highly
311 above contrast threshold. However, contrast sensitivity of the tested eye was significantly
312 lower in patients than in controls. Lower sensitivity in central vision might have modified the
313 appearance of the crowded stimuli in patients, making the target difficult to discriminate.

314 Indeed, when the flankers are too close to the target, the target remains visible, but its features
315 are confused with those of the flankers and observers perceive scrambled shapes.²⁴⁻²⁵

316

317 **Limitations:** There are several limitations to this research. First, studies investigating
318 crowding usually measure a critical target-to-flanker spacing using a threshold technique.
319 Accuracy was measured with a limited number of target-to-flanker spacing conditions.
320 Second, owing to random presentations in three different spatial locations, central fixation
321 could not be measured because the fixation cross would have masked the foveal stimuli. A
322 blocked presentation of foveal and parafoveal stimuli with a control of fixation for peripheral
323 presentation might have resulted in parafoveal crowding in patients. Third, the better eye was
324 tested in glaucomatous patients. Testing the worse eye, like Shamsy et al¹² might have
325 resulted in parafoveal crowding in patients. Fourth, as saccade latencies are shorter in
326 normally sighted observers than in glaucoma²⁶⁻²⁷ the cue and the 200 ms duration of the
327 stimuli might have triggered a saccade in parafoveal vision and placed the stimulus in foveal
328 vision thus explaining the high accuracy in foveal and parafoveal presentations for normally
329 sighted people. Finally, the patient group was heterogeneous in terms of visual field defect.

330 **Conclusion:** Reducing spatial uncertainty through exogenous visual cueing improved
331 performance in both foveal and parafoveal vision in glaucoma patients, without reducing
332 reliably the effect of central crowding. Cavanaugh et al²⁸ showed that endogenous orienting
333 of spatial attention during training can accelerate restoration of discrimination performance at
334 two blind field locations in cortically blind patients. They suggested that damage to the visual
335 system may limit visual resources available for deployment of attention across the visual field
336 rendering the limited information processed noisy. By directing resources toward a single
337 location through spatial cueing, these limitations can be partially overcome and people may
338 thus benefit from training. Glaucoma is different from cortical blindness but evidence from
339 neuroimaging studies show that glaucomatous damage also induces anatomical and functional
340 cortical changes with a significant decrease of grey matter density in visual areas.²⁹⁻³⁰

341

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FIGURE LEGENDS

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Fig.1. Schematic illustration and timing of the experimental paradigm for central and parafoveal presentations with pre-cueing. The 50 ms cue was immediately followed by the stimulus. When no cue was present, 50 ms were added to the 500 ms gap between fixation and stimulus.

Fig. 2. The 10-2 visual field of tested eye for each patient ordered as a function of the severity of the visual field defect.

Fig.3. Z-scores as a function of spacing conditions and cueing conditions in foveal vision (A) and in parafoveal vision (B) in patients with glaucoma and healthy controls. Error bars indicate the standard errors. Color dots correspond to individual observations.

Fig.4. Z-scores averaged over cue/no cue for each crowding condition (isolated T, no spacing HTH, spacing 0.3° H T H) in each of the 15 patients and the 15 controls for foveal presentations.

Table 1. Clinical and demographic data for patients and controls. The patients are ordered as a function of the Mean Deviation (MD) of the visual field. MD is a statistical index used to determine the average difference in visual field sensitivity compared to the mean sensitivity of a normally sighted observer of the same age. Acuity is expressed in Logmar. CS = contrast sensitivity, RE = Right eye LE = Left eye.

Glaucoma	Age	Gender	CS	Acuity	MD	Tested eye
1	66	M	1.96	0.0	-2.15	RE
2	75	M	1.49	0.0	-3.23	LE
3	79	M	1.71	0.0	-4.53	LE
4	71	F	1.67	0.0	-4.85	LE
5	71	M	1.56	0.1	-5.46	LE
6	64	F	1.59	0.0	-6.13	LE
7	40	F	1.81	0.0	-6.16	RE
8	67	F	1.63	0.1	-8	RE
9	70	F	1.24	0.0	-8.88	RE
10	47	F	1.9	0.1	-11.34	RE
11	60	F	1.99	0.0	-12	RE
12	63	F	1.33	0.1	-18.43	RE
13	81	M	1.46	0.0	-18.51	RE
14	68	F	1.74	0.1	-22.8	LE
15	47	F	1.41	0.1	-23.8	LE
Controls	Age	Gender	CS	Acuity	Tested eye	
1	67	M	1.77	0.0	LE	
2	64	F	1.83	0.0	RE	
3	75	M	1.69	0.0	LE	
4	60	F	1.86	0.0	RE	
5	58	F	1.83	0.0	RE	
6	61	F	1.58	0.0	RE	
7	69	F	1.85	0.0	LE	
8	53	M	1.94	0.0	RE	
9	60	F	1.99	0.0	LE	
10	75	M	1.64	0.0	RE	
11	60	M	1.89	0.0	RE	
12	67	M	1.88	0.0	RE	
13	78	M	1.75	0.1	RE	
14	60	F	1.84	0.0	LE	
15	61	F	1.47	0.0	LE	

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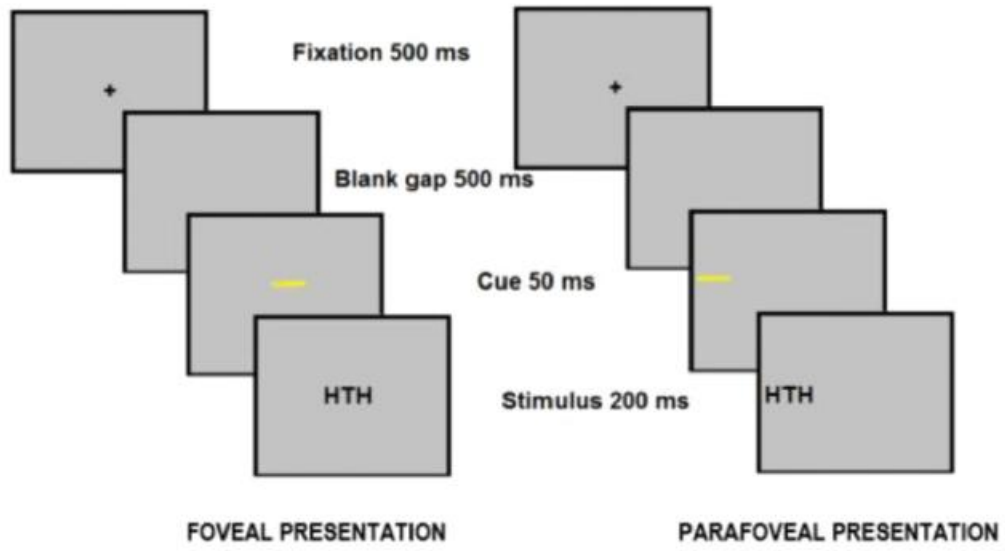
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458 Figure 1

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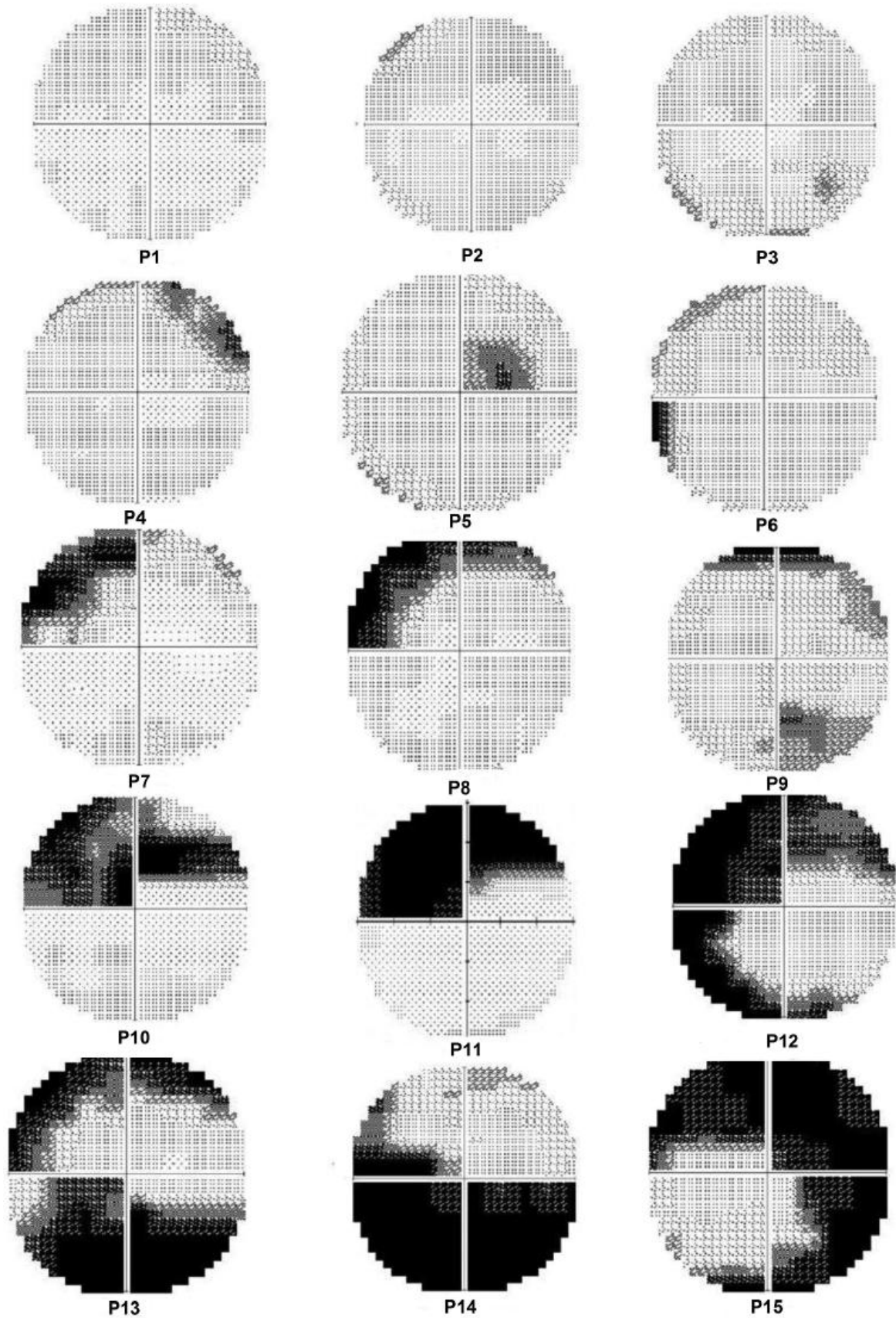
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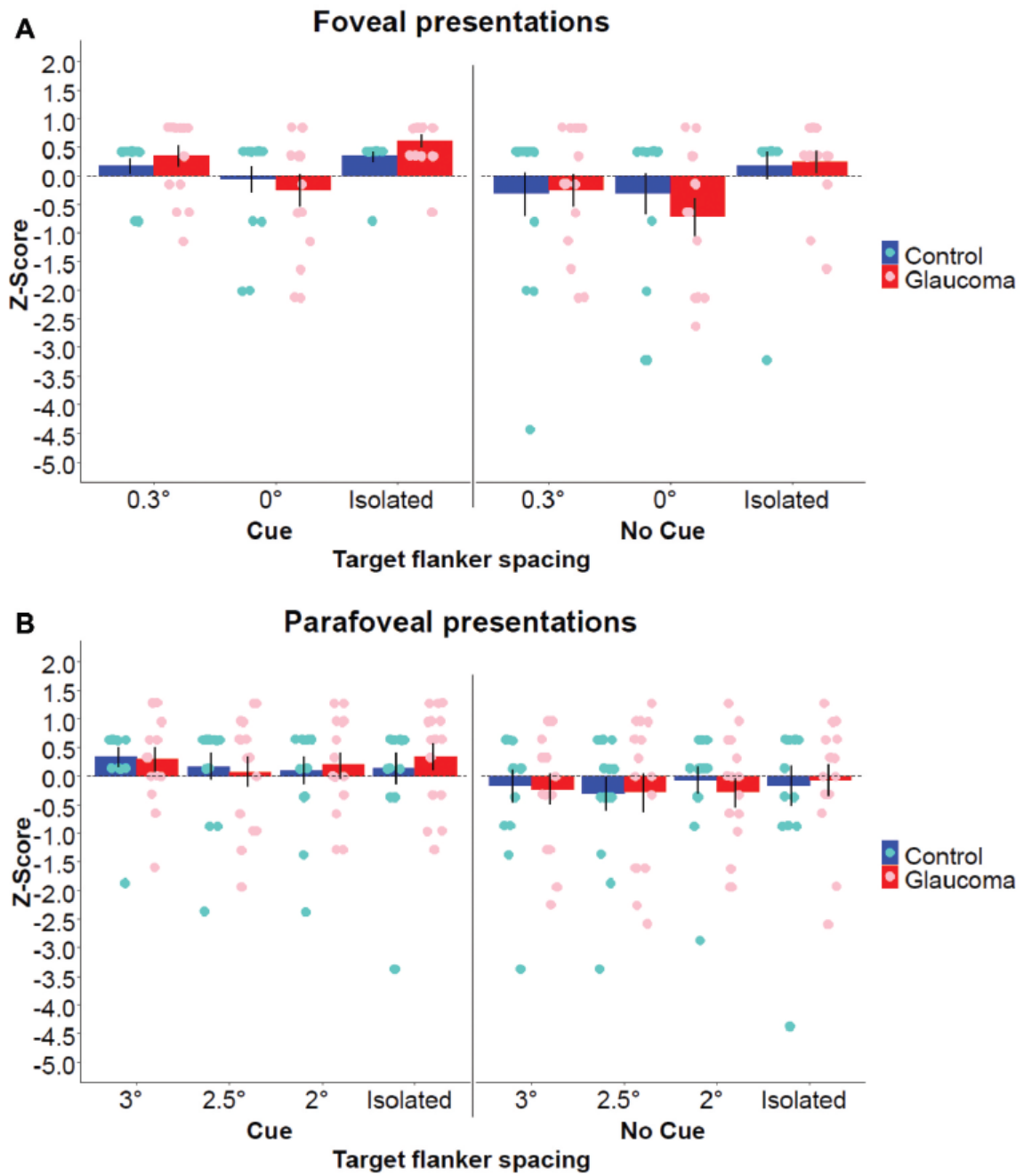
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465 Figure 2



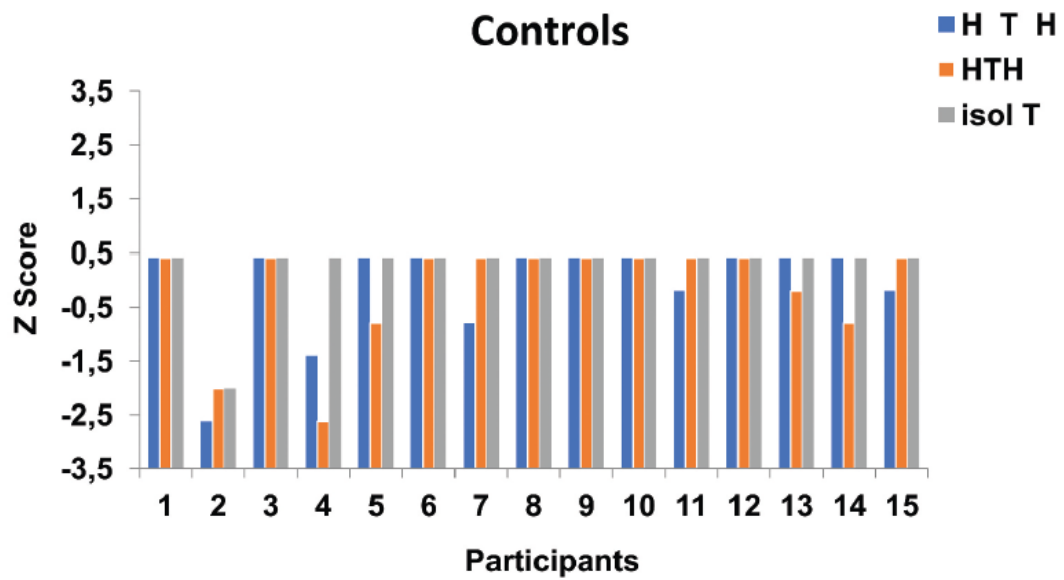
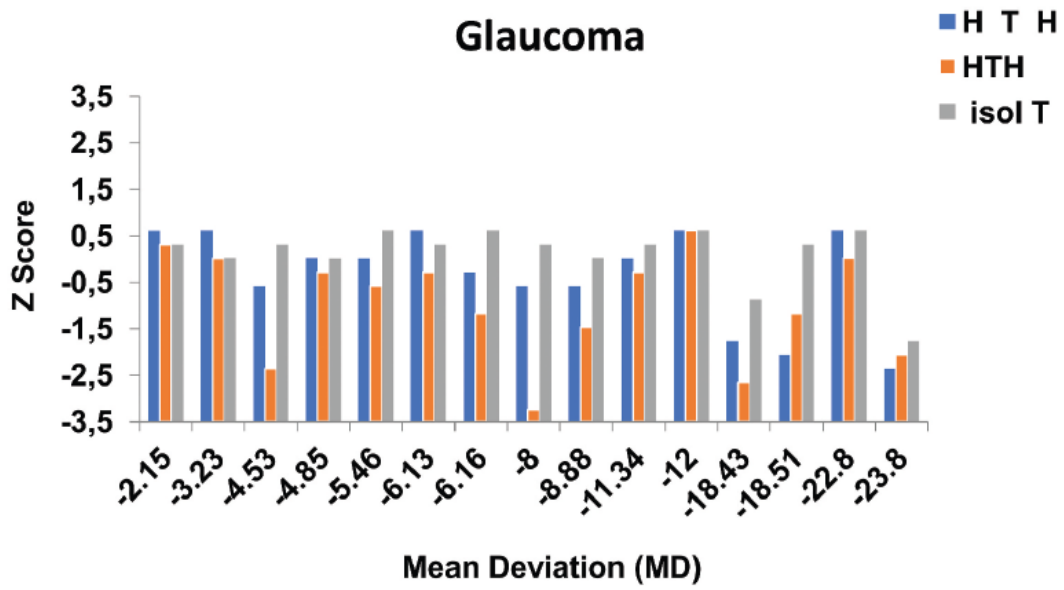
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470 Figure 4



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