Gaze-contingent modification can help to reduce ipsilesional attention bias

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Current treatments of visuo-spatial hemi-neglect mostly use top-down guided behavioral therapies: “just look left”. We reasoned whether bottom-up feature modification in visual exploration and visual search task might influence spatial attention.
In a first experiment we altered the visual saliency (and thereby attentional priority) of objects in a naturalistic scene along a left-right spatial gradient and investigated whether this can induce a bias in the exploratory eye movements of healthy humans (N=28). We developed a computerized mask, using “gaze- contingent” (GC) display technology that immediately and continuously reduced the saliency of objects on the left with respect to the head (body-centered) and the current position on the retina (eye-centered). In both experimental conditions, task-free viewing (FV) and goal-driven visual search (VS), this modification induced a mild but significant bias in visual exploration similar to hemispatial neglect.
In a second experiment we recorded gaze positions in 19 patients with left hemispatial neglect following right-hemisphere stroke and 22 healthy control subjects with the same paradigm. The patients’ median gaze position (Center of Fixation) in the original pictures was markedly deviated to the right in both tasks (FV: 6.8° ± 0.8; VS: 5.5° ± 0.7), reflecting the neglect-typical ipsilesional attention bias. GC modification significantly reduced this bias in FV (GC-HIGH: $d = -3.2 \pm 0.4°$; $p < 0.001$). Furthermore, in FV and VS, GC modification increased the likelihood to start visual exploration in the (neglected) left hemifield by about 20%. This alleviation of the ipsilesional fixation bias was not associated with an improvement in detecting left-side targets, in contrast, the GC mask even decreased and slowed the detection of right-side targets. Subjectively, patients found the intervention pleasant and most of the patients did not notice any modification.
GC technology can be used to positively influence visual exploration patterns in patients with hemispatial neglect. Despite an alleviation of the neglect-related ipsilesional fixation bias, a concomitant functional benefit (improved detection of contralesional targets) was not achieved. Future studies may investigate individualized GC-based modifications as augmented reality applications during the activities of daily living.