**Introduction**

* (1) Role of eye gaze in social context:
  + Visual system observes the gaze information from the world as a deictic cue to guide following behavior. – general across various species (Kano and Call; Shepherd)
  + Social perception automatically guide behavior (Allison et al.)
  + Evolutionary importance to humans:
    - compare to other primates, human infants almost exclusively follow the eye gaze direction – support Cooperative (mutualistic social interactions) Hypothesis (Tomasello et al.)
    - morphological development of human eyes (Emery)
  + Social relevance of direct gaze:
    - predation & likelihood of individuals to approach and engage others.
    - Shared mental states & constrains what information is relevant in the visual field (Shepherd); visuospatial attention (Senju and Hasegawa)
* (2) Crowd gaze:
  + Visual system can extract the collective gaze information efficiently from a crowd of faces as a summary of the crowd’s attention (Roberts et al.)
  + Information gain is amplified with crowd (later saturates) -- (Gallup et al.)
  + Ensemble encoding: (Sweeny and Whitney)
    - Ensemble encoding: averaged information, and the details of individuals are lost
* (3) Previous studies:
  + Whitney
    - Ensemble encoding: estimate the full crowd gazing direction based on the average gaze direction of the subset instead of basing on single gaze direction
    - Inverted face: reduced benefit gain from crowd gaze information
    - Caveats:
      * Did not answer how and when people utilize the cue to benefit social relevant tasks (e.g. visual search).
      * Use caricature faces -> unnatural stimuli, limited gaze directions, small set of faces (Full = 4 faces)
  + Sun
    - People follow the gaze of the majority
    - Caveats:
      * Head rotations may influence the response
      * Though the stimuli were more naturalistic, did not answer how the cue is used in real-life like situations
* Questions:
  + 1) Do people benefit from utilizing the crowd gaze cue? If so, when and how the benefit is amplified?
    - Original upright experiment
      * ASD with impaired facial social-relevant information processing (Bedford et al.; Hadjikhani et al.):
        + Whether the number of autistic traits predict the performance of the visual search?
  + 2) Is the social relevance critical in the crowd gaze cue? Require higher-level processing?
    - Inverted experiment
      * The mechanism involves processing of faces
      * Face inversion effect
  + 3) Whether crowd gaze primarily drives attention? Does misleading crowd gaze interfere with visual search?
    - Posner paradigm experiment
  + 4) Is this behavior reflexive/automatic?
    - Stroop effect experiment
* Predictions:
  + 1) Crowd gaze cue is utilized by people to facilitate visual search and it is amplified with larger crowd size.
  + 2) Misleading crowd gaze information interferes with visual search—increase search time and reduces accuracy.
  + 3) The mechanism of utilizing crowd gaze cue involves the processing of faces explicitly
  + 4) People are automatically exploiting the gaze cue when it is available in the crowd
  + 5) Individuals with higher AQ will benefit less from using the cue

**Method**

* Experiment tasks…
* Eye movement: Original, Inverted & Posner experiments
* Post-experiment survey: all experiments
* AQ questionnaire: Original experiments

**Experiment Design**

Experiment 1 – Original task

* N = 36 (22 with EM tracked)
* 9 conditions = 3 coherence levels [0%, 50%, 100%] x 3 distractor sizes [2, 4, 8]
* Behavioral results: interaction between gaze coherence and the number of distractors, which indicates that people are able to pick up the gaze cue in the crowd and use it efficiently, and the benefit gain increase with larger crowd size. However, individuals with more autistic traits do not necessarily have longer search time.

\*Task sequence of Experiment 2 & 3 is counterbalanced

Experiment 2 – Inverted task

* N = 38 (both experiments)
* Inverted - 9 conditions = 3 coherence levels [0%, 50%, 100%] x 3 distractor sizes [2, 4, 8]
* 450 trials
* Behavioral results: no interactions -> standard upward face processing is needed to extract the crowd gaze

Experiment 3 – Posner task

* N = 38
* 150 trials – 3 validity [Invalid, Valid, Neutral/Baseline]: 1:5:4
* Behavioral results: the validity of the cue influence people’s visual search performance.

\*Another 8 participants

Experiment 4 – Stroop effect task

* N = 8
* 300 trials – 3 congruence level [Incongruent, Congruent, Front-view/baseline] 1:1:1
* Behavioral results: the crowd gaze following is automatic

Results…

Discussion

* Require higher level processing -> facial representation/recognition

Conclusion

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