Investigating the validity of eye tracking's role in measuring attention shifting to valenced stimuli in formerly depressed persons.

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Introduction

- Cognitive models of depression pose that at-risk and depressed persons preferentially attend to mood-congruent information from which they have difficulty disengaging,[1,2] reflecting attentional control deficits. [3,4]
- Yet, the literature is mixed concerning such deficits in at-risk and depressed samples,[5] partly due to construct-irrelevant variance (e.g., motor speed) saturating some behavioral attention control measures.
- Visual attention-based paradigms have gained considerable interest as measures of attentional control over behavioral reaction-time measures of the construct (e.g., dot-probe task), which psychometric properties have been called into question in light of their poor reliability and convergent validity,[6,7] notably in cases where stimuli are presented for durations necessary to detect depression-related attentional bias (e.g., 1,000ms). [8,9]
- This study tests the clinical validity of a novel eye-tracking attention control task.[10]

Hypothesis

H_1: Slow disengagement from sad-valenced faces will be positively predicted by depression (i.e., active depression status, elevated depression symptoms, low positive affect (PA) and high negative affect (NA)).

H_2: Rapid disengagement from happy-valenced faces will be positively predicted by depression (i.e., active depression status, elevated depression symptoms, low positive affect (PA) and high negative affect (NA)).

H_3: Reaction time-based indices will mirror associations described in H1-H2.

Method

- Participants & Procedures
  - N = 198 adults with depression histories (46% female, *M* = 26.83 years old, *n* = 28 depressed).
- Procedures & Measures
  - Psychiatric Interviews – Structured Clinical Interview for DSM-5 Disorders
  - Beck Depression Inventory –II (BDI-II)
  - Positive and Negative Affect Schedule-X (PANAS-X)
  - Eye-tracking Task (see Figure 1).
    - Participants viewed 72 same-actor face-pairs (angry-neutral, sad-neutral, happy-neutral, neutral-neutral) drawn from the Karolinska Directed Emotional Faces database.[10]
    - Each trial began with a black screen (500ms) followed by a central fixation cross (500ms) and a random digit (i.e., 1-9) (1,000ms) that participants read aloud so as to orient their attention to the center of the screen prior to the face pair presentation. Face pairs were then presented during a "free viewing" period (3,000ms) that served as the conclusion for one-third of the trials.[11]
    - The remaining trials assessed participants' capacity to shift visual attention towards valenced faces (engagement) and away from valenced towards neutral faces (disengagement). Following "free viewing", participants' fixation for at least 100ms on the neutral face (engagement trials) or valenced face (disengagement trials) triggered a rectangular or oval probe to appear around the valenced face in the engagement trials, while the reverse occurred for disengagement trials. Participants keyed a corresponding response to the frame type ('z' for a "rectangle" and 'm' for an "oval") while their reaction times were collected.[11]

Method

- Eye-tracking Task
  - Visual Attention Indices – shifting speed away (i.e., time-to-first fixation) from a sad- or happy-valenced face towards a neutral face (disengagement), in reverse order (engagement), and across neutral face-pairs (valence-free shifting) in response to a visual prompt (i.e., a shape framing the target face) (see Figure 1).
  - Reaction Time Attention Indices – average reaction times on valid (i.e., correctly keyed & within the 201-999ms interval) engagement and disengagement trials.
- Analyses
  - Robust linear regression models were employed to accommodate the presence of influential outliers, and regressed demographic characteristics, neutral attention switching to accommodate method effects, valid trials comprising a given index (as warranted) and index validators (depression status, depression severity and negative and positive affect measures).

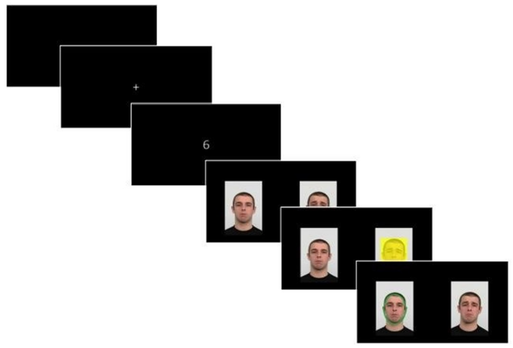

Figure 1. Eye-tracking Task.

Table 1. Descriptive statistics and bivariate correlation of study variables.

Variables	*M* (*SD*)	1.	2.	3.	4.	5.	6.	7.	8.	9.	1.	11.	12.	13.	14.	15.
1. Age	26.83 (2.636)	---														
2. Sex (female)	---	.18*	---													
3. N.Swtch	.352 (.068)	-.06	.07	---												
4. Dis.Sad	.352 (.068)	-.09	-.03	.67***	---											
5. Dis.Hap	.354 (075)	.03	.09	.65***	.64***	---										
6. Eng.Sad	.373(.092)	-.09	.06	.55***	.72***	.60***	---									
7. Eng.Hap	.370 (.079)	-.07	.06	.65**	.66***	.62***	.57***	---								
8. Dis.Sad.RT	.674 (.132)	-.05	.11	.08	.13	.16*	.07	.07	---							
9. Dis.Hap.RT	.672 (.124)	-.02	.13	.10	.16*	.20**	.10	.09	.84***	---						
10. Eng.Sad.RT	.672 (.120)	-.01	.12	.06	.16*	.16*	.03	.15	.78***	.83***	---					
11. Eng.Hap.RT	.683 (130)	.05	.14	.09	.17*	.26***	.10	.10	.84***	.84***	.81***	---				
12. Dep Dx.	---	.05	.12	.03	.15*	.11	.01	.09	.05	.07	.10	.13	---			
13. BDI-II	27.477 (1.283)	.05	.02	.04	.13	.13	.05	.06	.03	.08	.02	.09	.46***	---		
14. PA	24.477 (8.006)	.02	-.05	.06	-.07	-.04	.07	-.01	-.10	-.08	-.06	-.08	-.19**	-.39***	---	
15. NA	18.719 (7.489)	.02	.01	.02	.09	.06	.01	.03	.05	.09	.04	.08	.41***	.77***	-.26***	---

Note. N.Swtch = time-to-first fixation across the neutral-neutral valenced trials, Dis.Sad = time-to-first visual fixation on the neutral-valenced face relative to sad face, Dis.Hap = time-to-first visual fixation on the neutral-valenced face relative to happy face, Eng.Sad = time-to-first visual fixation on the sad-valenced face relative to neutral face, Eng.Hap = time-to-first visual fixation on the happy-valenced face relative to neutral face, RT = indices reflecting average reaction times, Dep Dx. = (0=not depressed, 1=currently depressed), BDI-II = Beck Depression Inventory-II, PA = PANAS-X Positive Affect subscale, NA = PANAS-X Negative Affect Subscale.

***$p \leq .001$, **$p \leq .01$ *$p \leq .05$

Results

- Eye-tracking based attention indices were strongly inter-correlated, as were their reaction time-based counterparts and depression indices (see Table 1).
- Eye-tracking based disengagement indices also generally positively correlated with longer reaction times across engagement and disengagement reaction time-based indices (see Table 1).
- Active depression status correlated with longer disengagement times from sad faces (see Table 1).
- H_1 As expected, current depression (β = .29, p = .02), low trait positive affect (β = -.14, p = .02), and depression severity at a trend (β = .06, p = .059) predicted slow sad-face disengagement.
- H_2 In contrast to expectation, happy face disengagement times were unrelated to depression measures.
- H_3 In contrast to the hypothesis, no reaction time-based index was predicted by depression measures.

Discussion

- Results suggest that shifting visual attention away from sad, but not positively-valenced information may be linked to active depressive states, and provide evidence for the eye-tracking-based task's incremental validity to behavioral parallels

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