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Blink Artifacts in EEG For Classifying Sight-read Music

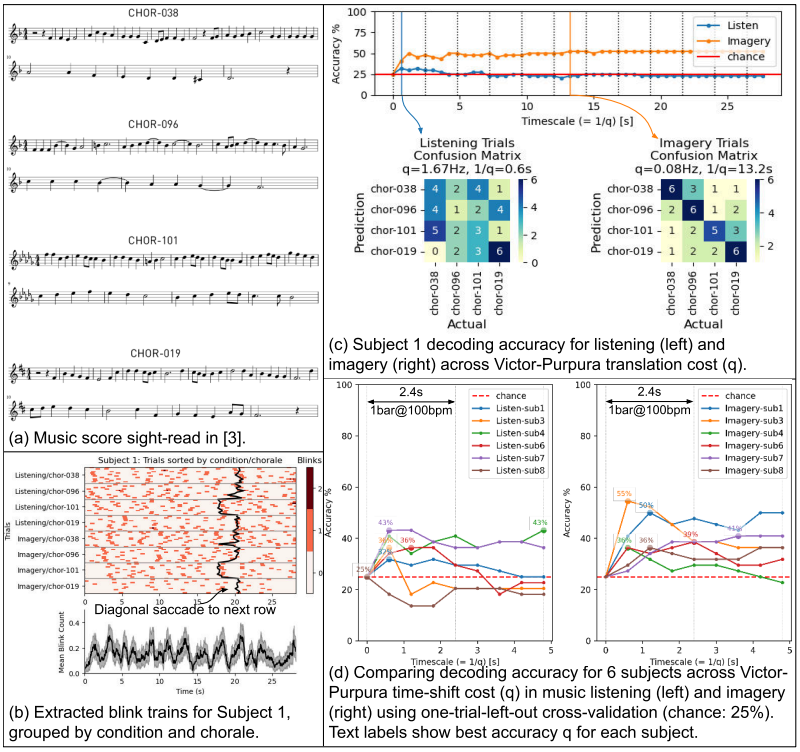
Abhinav Uppal[1]*, Dillan Cellier[1], Sean Bauersfeld[1], Shihab A. Shamma[2], Gert Cauwenberghs[1], and Virginia R. de Sa[1]

[1]*University of California – San Diego, La Jolla, USA,* [2]*University of Maryland, College Park, USA*

*9500 Gilman Dr, UCSD M/C 0412, PFBH 306, La Jolla, USA. E-mail: auppal@ucsd.edu

Introduction: Eye-movement related artifacts including blinks and saccades are significantly larger in amplitude than cortical activity as recorded by scalp-EEG, but are typically removed from analysis. Accumulating evidence indicates that spontaneous eye blinks are not necessarily random, and can be modulated by attention and cognition beyond just physiological necessities [1, 2]. In this exploratory analysis, we reanalyze a public EEG dataset [3] of musicians listening to or imagining music (Bach chorales) while simultaneously reading sheet music (Fig. 1a). We ask whether just eye blink activity during sight-reading in music listening and imagery is sufficient to identify the musical piece being read.

Material, Methods and Results: We analyzed data from [3], where musicians listened to or imagined one of four Bach chorales 11 times each, totaling 88 trials per subject. 6 subjects' blink times were extracted using BLINKER [4] and manual inspection for all trials (Subject 1: Fig.1b). A spike-train distance metric (Victor-Purpura distance [5]) was used to compare intra-subject blink timings between the four chorales and listening/imagery conditions, Fig.1c. One trial-left-out cross-validation was used to identify the music based on the left-out trial's blink-distance from the 10 remaining trials with above chance level accuracy (best subjects: ∼50% in imagery, chance: 25%). Accuracy varied with subject, condition, and a cost factor q for shifting blink times, Fig.1c–d.



(a) Music score sight-read in [3].

(b) Extracted blink trains for Subject 1, grouped by condition and chorale.

(c) Subject 1 decoding accuracy for listening (left) and imagery (right) across Victor-Purpura translation cost (q).

(d) Comparing decoding accuracy for 6 subjects across Victor-Purpura time-shift cost (q) in music listening (left) and imagery (right) using one-trial-left-out cross-validation (chance: 25%). Text labels show best accuracy q for each subject.

Figure 1: *(a) 4 chorales were sight-read by musicians while listening to or imagining music with vibrotactile cueing at 100 bpm, (b) extracted eye blinks plotted as dashes for 88 trials (4 chorales × 2 conditions × 11 trials), with diagonal saccades between music rows, (c) Decoding accuracy for Subject 1 based on shortest Victor-Purpura distance of tested trial's blink timing against remaining 10 training trials, (d) decoding accuracies for 6 analyzed subjects.*

Conclusion: Artifactual eye-blink timing could still be task-relevant and may supplement brain decoding performance when utilized.

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