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Passive Neuroart BCI for Health: A Perspective

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Introduction: Engaging with art can be beneficial for health and well-being [1]. Neural correlates of art perception related to attentional, affective and hedonic processes are already used in Brain-Computer-Interfaces (BCIs) [2]. Therefore, we think that positive effects of aesthetic experience (AE) can be optimized by BCI. This work elaborates on potential health applications combining neuroart and passive BCI for neuroadaptive art presentation. Finally, we offer perspectives on new methods to further the development of such applications.

Neuroadaptive art presentation: As AE is highly subjective [3], we hypothesize that health benefits of art perception could be optimized by neuroadaptive art presentation. Here, the user's brain activity would be monitored by passive BCI during art perception. This information would then be fed into a recommender system in order to present subject-specific art that evokes desirable neural and mental states. Different optimization targets would result in different applications. For example, brain activity related to stress and relaxation during art gazing could be monitored to select art works that minimize a user's stress level. As artworks particularly afford attention [4], we also see potential for neuroadaptive art presentation in attention training. Such a study would assess markers of sustained attention to inform the selection of art that engages attentional capacities, or, in the context of dementia neurobiomarker elucidation, to inform the design of reminiscent interior images, as outlined in [5]. Although this technology could be beneficial, ethical concerns exist. For example, brain responses to caricatures or nudes could reveal political or sexual preferences. Thus, data privacy and responsible use should be technically ensured.

Perspective on Methods: Current AE decoding approaches impose unnatural art engagement constraints on participants, e.g. rating tasks, which biases neural activity [2]. Therefore, novel and naturalistic BCI protocols are needed. Instead of subjective ratings, engagement time could be used to implicitly label trials according to art appreciation [6]. As users might then gaze at only a few artworks for a long time and training data could be sparse, we propose leveraging unsupervised federated learning (FL) as outlined in [7]. This collaborative technique offers several advantages in the context of neuroart passive BCI, because FL facilitates efficient training while ensuring participant privacy.

Conclusion: This research perspective demonstrates the potential of personalized and privacy-preserving neuroart passive BCIs for well-being interventions. Future research should address the unique challenges of implementing diverse art modalities (visual, auditory, somatosensory, olfactory, etc.) in neuroart BCI scenarios. Key areas of focus include, ensuring fairness and equity across diverse populations, enhancing the security of FL systems and optimizing AE decoding performance which remains challenging. Furthermore, rigorous randomized controlled trials are essential to evaluate the effectiveness of neuroadaptive art presentation in improving health and well-being outcomes.

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