Lessons Learned: Navigating Developmental Psychophysiology from Infancy to Adulthood

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Psychophysiology offers powerful tools that can be used to investigate children/adolescents and their development. However, using these tools in such cohorts also presents unique challenges. In this symposium, researchers will present results from recent developmental psychophysiology studies, and discuss challenges that can be encountered in such research and possible solutions. To start, the organizers will give a brief introduction covering the importance of adapting psychophysiological approaches and designs to developmental perspectives. Following this, Danielle Rice will present a study investigating developmental changes in HRV across middle childhood and discuss how the functional implications of such parameters may need to be considered in a developmental context. Thereafter, Olga Boer will use a recent study examining cognitive control in over 2500 adolescents to discuss the constraints and challenges faced in collecting, processing, and handling large developmental datasets. In the third talk, Emilio Valadez will use recently collected fMRI data to discuss the practical data collection and processing considerations necessary for conducting such studies in developmental samples. Echo Xu will then conclude the talks by discussing a newly developed tool for estimating the reliability, effect size, and data quality of EEG data in infants and children. Finally, the symposium will conclude with a panel discussion regarding developmental psychophysiology and its challenges. Our aim for this symposium is to emphasize the use of psychophysiology in developmental research.

Presentation 1:

DEVELOPMENTAL CHANGES IN RESTING HEART RATE VARIABILITY PREDICTING PEER SUCCESS: FROM AN INDEX OF ENVIRONMENTAL SUSCEPTIBILITY IN KINDERGARTEN TO EMOTION REGULATION IN 1ST GRADE

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Abstract:

Resting HRV has been associated with emotion regulation capacity among adolescents and adults, but findings have been less consistent among young children leading to the postulation that associations between low resting HRV and risk for psychopathology are developmentally emergent. We examined how resting HRV related to children's ability to make friends in early elementary school, and whether the socioemotional context (teacher closeness) moderated this association, from two theoretical frameworks of HRV: 1) in an emotion regulation framework higher HRV would buffer environmental effects on children's peer success, 2) in a differential susceptibility framework higher HRV would have positive effects on peer success in the context of high teacher closeness, but negative effects in the context of low teacher closeness. 339 children (M_{age} = 66.32 months [SD_{age} = 4.13], 70.2% Black, 64.3% male) were recruited in Kindergarten(K), including resting HRV, teacher-reported closeness, and peer sociometrics. Assessments were repeated annually through 2nd grade to examine whether the functional association of HRV changed across this developmental period. Results in K were consistent with the different susceptibility framework such that higher resting HRV was associated with lower peer success in the context of low teacher closeness. However, in 1st grade results were consistent with the emotion regulation framework where higher resting HRV had a main effect on peer success. Results suggest that the functional implications of HRV may need to be considered in a developmental context.

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Presentation 2:

VALIDATING EEG MEASURES OF COGNITIVE CONTROL AMONG A SAMPLE OF OVER 2500 ADOLESCENTS

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Abstract:

Characterizing the dynamics and individual differences in neural markers of cognitive control is a key interest within the cognitive and clinical neurosciences. However, few studies have examined how these neural markers manifest during adolescence, and large population-based electroencephalographic (EEG) studies are scarce. This study aims to validate the N200, p300, error-related negativity and error positivity observed during a go/no-go task in a large sample (N = 2625, M_{age} = 18.4, age range 16-20). Preliminary results will be presented, including associations between child and family characteristics and ERP parameters. In addition, several practical considerations (e.g. the use of a low-density EEG set-up) as well as EEG preprocessing pipeline decisions will be discussed. This large-sampled study provides unique insights into task and sample characteristics of performance monitoring experiments, as well as indications for choosing covariates and confounders in adolescent EEG studies.

FUNDING: Stichting Volksbond, Rotterdam, the Netherlands

Presentation 3:

GROWING MINDS IN MOTION: PRACTICAL CONSIDERATIONS FOR CONDUCTING FMRI WITH SCHOOL-AGE CHILDREN

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Abstract:

Brain functional magnetic resonance imaging (fMRI) research in children enhances our understanding of neural development and of factors that may influence neurodevelopmental trajectories. However, collecting high-quality fMRI data in younger populations raises unique challenges. Relative to adults, children are more likely to have difficulty avoiding motion artifacts, to experience scanner-related anxiety and scanner fatigue, and to misunderstand task instructions – often resulting in larger numbers of excluded participants than their older counterparts. In addition to these data collection challenges, analysis of children's fMRI data also requires special considerations. For example, reliance on adult brain templates and on the canonical hemodynamic response function used by most fMRI analysis software packages may bias developmental findings. This talk will present approaches to mitigate each of these challenges, using as an example a recent fMRI study examining the long-term neurodevelopmental effects of an infant parenting intervention.

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Presentation 4:

ADVANCING THE REPORTING OF DEVELOPMENTAL EEG DATA: TOOLS FOR ESTIMATING RELIABILITY, EFFECT SIZE, AND DATA QUALITY METRICS

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Abstract:

Children present unique challenges in EEG studies due to shorter recordings and increased artifacts. Therefore, it is crucial to develop tools that maximize data collection, improve reproducibility, and facilitate inclusion in large-scale longitudinal studies. Efforts have made strides in automating preprocessing, yet current developmental EEG studies often lack consistency in reporting reliability, effect sizes, and data quality metrics. To address this gap, we developed a novel tool to estimate reliability, effect size, and data quality (e.g., standardized measurement error) in EEG data. The tool features user-friendly software along with bootstrapped estimates to guide decisions on trial numbers for the inclusion of participants and task optimization for future study designs. Our presentation will demonstrate this tool's utility for enhancing metric reporting in popular EEG pipelines. We will apply the tool to large, longitudinal datasets of infants and children, generating reliability, effect size, and data quality estimates in three commonly used paradigms: visual perception, face perception, and resting state. Overall, our efforts aim to improve the quantification and reporting of reliability, effect size, and data quality estimates to inform robust understanding of cognitive and affective processes in EEG studies, fostering higher standards of reliability and reproducibility in developmental neuroimaging research.

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