Supplemental Online Content

Maza MT, Fox KA, Kwon SJ, et al. Association of habitual checking behaviors on social media with longitudinal functional brain development. *JAMA Pediatr*. Published online January 3, 2023. doi:10.1001/jamapediatrics.2022.4924

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Study Procedures

1. Participant recruitment:

For this current study, participants had to be at least 12 years old and in 6th or 7th grade, or within 2 months of turning 12 years old, at wave 1 of data collection. A total of 178 participants were recruited for the study. Participants were excluded if they had any metal in their body including braces or permanent retainer. Other exclusion criteria included claustrophobia, history of seizure or head trauma, learning disability, and non-fluency in English. If participants regularly took medications (e.g., ADHD medication), they were asked to do a 24-hour medication wash prior to the scan.

Of the 148 recruited participants at wave 1, 5 were excluded due to major claustrophobia during fMRI session or non-fluency in English and not invited back for later waves. In the current study, 3 participants were further excluded from analyses for incomplete data (including not completing the self-report measure of interest) or completing the task behaviorally, outside of the scanner, two were excluded for excessive motion in the scanner (> 2 mm in any direction), one for scan-related technical errors, and one for an MRI artifact leading to a final wave 1 sample size of 136 participants (Mage = 12.8, SDage = 0.52; range = 11.9-14.5; n = 71 female). At wave 2, 27 participants from cohort 1 indicated they did not want to participate or lost contact, and so 117 participants from cohort 1 and 30 new participants from cohort 2 participated. Of the 147 participants that completed wave 2, 8 were excluded for completing the task outside the scanner, 6 for not completing the task, 1 for scanner-related technical errors, and 1 for not completing the self-report measure of interest for a final wave 2 sample size of 131 participants (Mage = 13.7; SDage = 0.59; range = 12.4-15.4; n = 68 female). At wave 3, 7 participants indicated they did not want to participate or lost contact, and 6 participants who participated in wave 1 but skipped wave 2 returned for wave 3 of the study, and so 119 participants from cohort 1 and 26 participants from cohort 2 participated. Of the 145 participants, 18 participants were excluded due to completing the task behaviorally, 1 for not completing the task, 1 for falling asleep in the scanner and 1 for not completing the self-report measure of interest for a final wave 3 sample size of 124 participants (Mage = 14.7; SDage = 0.60; range = 13.4-16.3; n = 61 female). Adolescents who began the study at wave 1 had up to 3 waves of data, and those who began the study at wave 2 had up to 2 waves of data.

2. Data procedure:

At each wave of data collection, participants completed behavioral and fMRI tasks as well as self-report questionnaires, totaling a 4-hour session with a 1.5 hour fMRI session. Prior to completing the fMRI scan, participants received training for the tasks, were acclimated to a mock scanner, and completed self-report measures. In the event the participant could not participate in the fMRI session after the first wave (e.g., braces), they completed the tasks behaviorally, outside of the scanner. At the end of the session, participants received monetary compensation ($90), prizes worth up to $20 for doing well in the scan (e.g., gift cards, headphones), and a meal after the scan. The participating parent/guardian received monetary compensation ($50), parking and gas reimbursement ($27), and a meal. At each subsequent wave, returning families received an additional $25 returning bonus (i.e., additional $25 for completing 2 waves; additional $50 for completing 3 waves).

3. fMRI image acquisition:

A high-resolution T2*-weighted echo-planar imaging (EPI) volume (TR = 2000ms; TE = 25ms; matrix = 92 x 92; FOV = 230mm; 37 slices; slice thickness = 3mm; voxel size = 2.5 x 2.5 x 3mm^3) was acquired coplanar with a high-resolution T2*-weighted, matched-bandwidth (MBW), structural scan (TR = 5700ms; TE = 65ms; matrix = 192 x 192; FOV = 230mm; 38 slices; slice thickness = 3mm). In addition, a T1* magnetization-prepared rapid-acquisition gradient echo (MPRAGE; TR = 2400ms; TE = 2.22ms; matrix = 256 x 256; FOV = 256mm; 208 slices; slice thickness = 0.8mm; sagittal plane) was acquired. The orientation for the EPI and MBW scans was oblique axial to maximize brain coverage and to reduce noise.

Preprocessing was conducted using FSL (FMRIB's Software Library, version 6.0; www.fmrib.ox.ac.uk/fsl) and included the following steps: skull stripping using BET; motion correction with MCFLIRT; spatial smoothing with a Gaussian kernel of 6mm, full-width-at-half maximum; high-pass temporal filtering with a filter width of 128s (Gaussian-weighted least-squares straight line fitting, with sigma = 64.0s); grand-mean intensity normalization of the entire 4D dataset by a single multiplicative factor; and individual level ICA denoising for artifact signal using MELODIC (version 3.15), combined with an automated signal classifier[1] (Neyman-Pearson threshold = .3). For the spatial normalization, the EPI data were registered to the T1 image with a linear transformation, followed by a white-matter boundary-based transformation using FLIRT, linear and non-linear transformations to standard Montreal Neurological Institute (MNI) 2-mm brain using Advanced Neuroimaging Tools, and then spatial normalization of the EPI image to the MNI. Quality check during preprocessing and analyses ensured adequate signal coverage.

eReferences

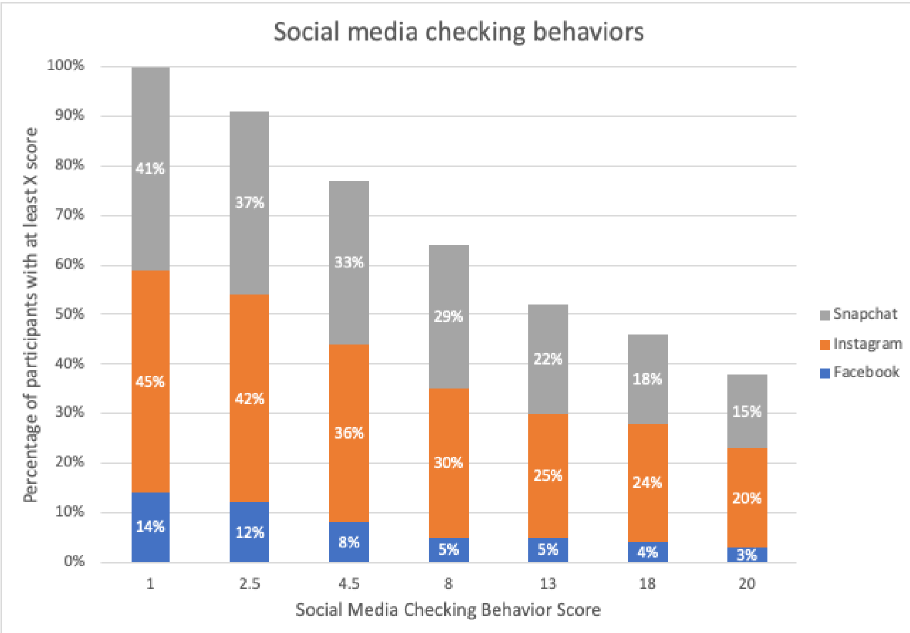
1. Tohka J, Foerde K, Aron AR, Tom SM, Toga AW, Poldrack RA. Automatic independent component labeling for artifact removal in fMRI. *NeuroImage*. 2008;39(3):1227-1245. doi:10.1016/j.neuroimage.2007.10.013

eTable. Age-Related Neural Changes as a Function of Social Media Checking During Social Feedback

Anatomical Region	x	y	z	T-Statistics	Cluster Size
Anterior Insula	-30	-16	-6	25.4	280
Posterior Insula	-44	-2	-2	23.3	160
Superior Frontal Gyrus	-16	4	58	26.7	157
Dorsal Anterior Cingulate Cortex	8	-16	38	24.8	154
Precuneus	-14	54	42	20.7	115
Striatum	-20	-8	2	25.2	103
Middle Cingulate Cortex	-18	32	48	22.4	103
Cerebellum	-44	72	-30	21.4	83

Table S1. Clusters that survived cluster-extent threshold correction when modeling longitudinal whole-brain changes in sensitivity to social feedback for adolescents who reported social media checking behaviors using AFNI 3dLMEr.

eFigure. Descriptive Statistics of Social Media Checking Behaviors



eFigure. Descriptive statistics based on social media checking behavior score.