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Does Adolescent Digital Technology Use Detract from the Parent-Adolescent Relationship?

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Abstract

A population-representative sample of young adolescents (N=2104, mean age 12.4) reported on digital technology use and relationships in 2015. A subsample (N=388) completed a 14-day ecological momentary assessment in 2016–2017 via mobile phone. Across the 2104 adolescents, those who reported more social networking site (SNS) engagement were more likely to live in families characterized by more family chaos, and to report that their online experiences resulted in problems with their parents. However, when the subsample of adolescents was followed daily, there was little consistent evidence that adolescents' quantity of daily digital technology use detracted from the amount of time they spend interacting with close others (including parents) nor that adolescent daily technology use was associated with more negative or less positive parent-adolescent interactions.

Keywords

Adolescence; technology; parenting; parent-adolescent interactions; screen time

Mobile technologies are increasingly ubiquitous, with 95% of adolescents in the United States today having regular access to a smartphone (Anderson & Jiang, 2018) and 84% owning their own smartphones (Rideout & Robb, 2019). Mobile devices are also ever-present within the family context, where they are often used to facilitate family communication and connection (Williams and Merten 2011), but may also lead to difficulties like distraction (Coyne et al., 2017) and conflict regarding the amount of time that young people are spending online (Zhang & Livingstone, 2019). It is critical to understand whether technology use detracts from parent-adolescent relationships, as a large

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literature supports the important role of positive, engaged parent-child relationships in promoting healthy adolescent psychosocial outcomes (Dishion, Nelson, & Bullock, 2004; Laursen & Collins, 2009).

The present study extends prior retrospective and cross-sectional reporting on how mobile device use is perceived to impact parent-adolescent relationships by capturing daily-level measures of time spent on digital technology alongside child perceptions of parent-adolescent interactions and social relationships using Ecological Momentary Assessment (EMA; Shiffman et al., 2008). Brief surveys were administered to young adolescents multiple times daily via mobile phones to examine whether digital technologies, particularly mobile phone usage, *detracted from parent-adolescent relationships* (through displacement, distraction, or spurring conflict). EMA allows for the collection of adolescents' perceptions of parent-adolescent interactions and related events in real time and in ways that are often difficult to reliably capture when relying solely on retrospective self-report (e.g. ways that people allocate their time over the day). Importantly, the intensive longitudinal nature of our EMA study allowed us to differentiate between *who* study questions (between-person comparisons; i.e. do youth who use digital technology more frequently experience worse parent-adolescent interactions, compared to other youth?) vs. *when* study questions (within-person comparisons; i.e. do youth experience worse parent-adolescent interactions on days when they use more versus less technology, compared to themselves? do linkages between digital technology use and parent-adolescents interactions persist across days?). These within-person, *when* associations allow for the adolescent to serve as his or her own control across time, testing whether changes in adolescents' daily technology use are associated with *within-individual* risk and protections holding all potential person-level confounds constant over time. It is imperative that we distinguish between these two types of processes, because we cannot reliably infer within-individual processes from between person data and associations (Fisher, Medaglia, & Jeronimus, 2018).

Adolescent Digital Technology Use as a Potential Detractor from Parent-Adolescent Relationship

Fears have been raised that adolescents' frequent use of digital technologies can detract from "real life" relationships, either by displacing face-to-face interactions, distracting from quality time spent together, or by spurring family conflict (e.g. Turkle, 2016). Concerns about the impact of digital technologies on family relationships are particularly salient in early adolescence, when youth are increasingly interested in and allowed to enter online spaces (Anderson & Jiang, 2018; Blair & Fletcher, 2011) and when the parent-adolescent dynamic is rapidly evolving (especially around conflict and autonomy; Laursen, Coy, & Collins, 1998). However, not all parents see adolescent digital technology engagement as a net negative for their relationship; for instance, in a nationwide study of 1,240 US parents, 18% of parents reported that their child's use of mobile devices mainly helps their parent-child relationship, 15% reported that it mainly hurts their relationship, and 67% reported that it makes no difference (Common Sense Media, 2016).

The displacement hypothesis asserts that time youth spend on technology supplants time that they would otherwise spend doing socially or cognitively beneficial activities (Kraut et al., 1998). Early research in the late 2000s suggested that time spent on computers for certain purposes (communication and recreation) was associated with less time spent interacting with parents (Lee, 2009). However, more recent research has failed to support the displacement hypothesis. For example, one study of German social media and IM users age 16 and over, showed that —rather than reducing time spent interacting with friends, family, and acquaintances— time spent communicating on social networking sites was actually associated with *more* time spent in face-to-face communication six months later (Dienlin, Masur, & Trepte, 2017). Furthermore, the displacement hypothesis does not seem to extend to relationship *quality*; two studies have failed to find associations between quantity of technology use and worse parent-child relationships (Lee, 2009; Willoughby, 2008).

Distraction by technology is related to, but distinct from, displacement by technology, and many families report that distraction is a problem. Indeed, 77% of parents reported that their teens get distracted by devices and don't pay attention while they are together at least a few times every week (Common Sense Media, 2016). This is particularly worrisome in light of research findings which suggest that *engaged* time spent with parents is associated with better adolescent psychosocial outcomes (Milkie, Nomaguchi, & Denny, 2015). This phenomena of technology-driven distraction in close relationships has been reported in both parents and teens; In a recent national sample of 1072 10–20 year old youth, 85.5% of *youth* reported being distracted by technology while interacting with their parents at least some of the time (with 77.5% reporting that their *parents* get distracted by technologies at least some of the time; Stockdale et al. 2018). That same study concluded that parents' technology-driven distraction was related to lower adolescent perceptions of parent warmth, but adolescent perceptions of their own distraction around their parents was not (Stockdale et al., 2018).

Lastly, technology use is an often-cited cause of conflict in the parent-child relationship, often when parents disagree with the quantity or nature of children's technology use and attempt to limit it. Adolescence has long been a known risk corridor for parent-child conflict, especially around issues of personal jurisdiction (e.g. how a teen spends his or her time; Smetana, 2002). Indeed, time spent on devices seems to serve as a frequent spark for conflict in contemporary families, with 32% of teens and 36% of US parents reporting that they argue about device use *on a daily basis* (Common Sense Media, 2016). In a nationally representative sample of 2,032 UK parents, amount of child screen time was one of the most commonly cited sources of parent child conflict, though far fewer parents reported conflict over what their children were *doing* online (Zhang & Livingstone, 2019). Furthermore, 13% of US teens ages 12 to 19 have reported having had an experience on a social networking site that caused a problem with their parents (Lenhart et al., 2011).

The Present Study

Much of our existing understanding of associations between adolescent use of digital technologies and family relationships has been based on cross-sectional studies with inadequate statistical controls, and thus our ability to isolate independent associations, as

well as infer causality or directions of associations are limited. There is evidence that both digital technology use (George et al., 2020; Jensen, George, Russell, & Odgers, 2019; Twenge, Martin, & Spitzberg, 2019) and parent-adolescent relationship features (Collins & Laursen, 2004; Shek, 1998) vary by race/ethnicity, gender, age, and economic disadvantage. Indeed, we know from our own work in this sample that older adolescents tend to spend more time using technology for purposes such as communication, schoolwork, and total screen time, as do African American and Hispanic/Latino students and those from economically disadvantaged backgrounds (Jensen et al., 2019). Studies that omit these variables (which are associated both with the dependent variables measuring parent-adolescent relationship features and the independent variables measuring digital technology use) from analyses are at serious risk for third variable confounding of associations. Thus, for our between-person analyses ("who", questions) we are able to control for a set of covariates that are often neglected in prior research and which are most likely to confound observed associations between digital technology use and adolescent-parent relationships. This offers an advantage given that, without adequate controls, it is impossible to know whether initial associations we observe between technology use and parent-child interactions are driven by some other third factors such as family income or age. In our within-person analyses, the study design offers the advantage of using each person as their own control, which effectively holds constant fixed factors such as each adolescents' age and current socioeconomic status and allows for an estimation of associations between digital technology use and parent-child relationships while holding these potential confounds constant by design.

The present study extends our existing knowledge of displacement, distraction, and conflict due to digital technologies and tests whether contemporary adolescents' self-reports of their digital technology use is associated with more negative perceptions of parent-adolescent social relationships by addressing the following questions: **Question 1:** Are adolescents growing up in homes characterized by more technology-related conflict with parents, chaos at home and lower levels of parenting monitoring also using digital technology more frequently? Question 1 is addressed through cross-sectional comparisons between all of the adolescents participating in our population-representative study (N=2104) and adjusts for potential confounding by demographic characteristics (age, gender, economic disadvantage, and race/ethnicity). **Question 2:** Do adolescents report worse quality offline interactions with their parents on days when they use more versus less digital technology? **Question 2b:** Do adolescents with higher average daily technology use across the 14-day EMA period also report worse daily parent-child offline interactions across the study period? Although study Question 2 is designed to yield valuable insight into the daily co-occurrence of parent-adolescent offline interactions adolescent digital technology use, it does not help us understand which comes *first* (which process is driving the other over time). Thus, we tested a third study question, **Question 3:** Do the associations tested in Q2 (between daily digital technology use and offline-parent interactions) persist to the next day? Questions 2 and 3 examine these associations using a subsample of adolescents who completed a 14-day ecological momentary assessment (the EMA subsample; N=388).

Method

Sample and Procedure

The study design is depicted in Supplemental Figure 1 and described in full detail elsewhere (Jensen et al., 2019; Rivenbark et al., 2019). The sample of 2,104 students was drawn from the entire population of children enrolled in grades 3–6 in North Carolina Public Schools during the 2011–2012 school year based on administrative data from the North Carolina Department of Public Instruction (NCDPI). Approximately 25,000 students were randomly selected from the population for contact, resulting in the target sample of goal of ~2000 participants who were representative of the larger student body. At the time of the Baseline Adolescent Survey (collected between April and August of 2015), participants were enrolled in grades 5–8 and ranged in age from 9 to 15 (M_{age} = 12.36, SD = 1.12). The sample was representative of the state population of public-school children with respect to economic disadvantage, gender, and ethnicity. Participants and their parents were contacted and consented by phone. Adolescents were surveyed by phone and reported on demographics, mental health, and problem behaviors. The majority of parents provided consent to link survey data to administrative data from the NCDPI (n = 2048, 97.3%) and gave permission to contact their child for future studies (n = 1867, 88.7%).

A subsample of 395 early to mid-adolescents were recruited to participate in a Home Visit and a 14-day EMA between April 2016 and February 2017. The vast majority of adolescents (94%) fell between the ages of 12–15 (full range = 10–17 years of age) at the time of the EMA. Adolescents were selected based on their: 1) proximity to two geographically distinct locations (central, urban NC, and western, rural NC) from which staff could make in-person home visits (1275 adolescents eligible), and 2) representation to the statewide public-school population in terms of economic disadvantage, gender, race, and ethnicity. We recruited among this eligible sample until we reached the target N=400. The 395 adolescents who agreed to participate in the EMA were fairly representative of the population, though more likely to be White (60.6% versus 51.3%) and less likely to be economically disadvantaged (measured as current receipt of free/reduced lunch; 40.8% versus 55.4%) compared to the overall state public school population (Jensen et al., 2019). All procedures, protocols, and measures were approved by the Duke University Institutional Review Board for the study (approval #D0396).

The Home Visit was conducted by two interviewers who installed a survey application (MetricWire Inc. 2016) on either the participant's own mobile phone (49.9%) or a study-provided phone (which was not equipped with texting or calling capabilities) and walked them through a practice survey with a take-home reference guide. Participants received $1 per EMA survey completed, with those with at least 80% compliance receiving the full $42. For each day of the 14 days that participants completed all three surveys (in the morning, afternoon, and evening), they were entered into a drawing to win a wearable fitness tracker used in the study. Of the 395 adolescents who completed the home visit, 388 adolescents completed at least one EMA survey for the present study and comprise our analysis sample. Eighty percent of prompts were answered, yielding 13,017 observations over 5,270 study days (an average of 33.5 surveys per person; 70% of participants answered ≥ 70% of

prompts). Survey questions assessed participants' daily experiences, technology use, behaviors, and mood.

Measures

Covariates.—At the initial Baseline Adolescent Survey adolescents reported their birthdate, *gender* (52.1% female), race, and Hispanic ethnicity. *Race/Ethnicity* was re-coded into four categories reflecting White (not-Hispanic; 51.5% of sample), Black (not-Hispanic; 22.8% of sample), Hispanic (of any race; 14.5% of sample), and other race/ethnicity (including Asian, American-Indian, Native Hawaiian/Pacific Islander, multiracial, and those who did not report on race/ethnicity; 11.2% of sample). *Age* was calculated based on self-reported birthdate and the date of the baseline adolescent survey (M_{age}=12.36, SD=1.12) and date of first EMA survey (M_{ageEMA} = 13.37, SD = 1.14). Family *economic disadvantage* was determined based on eligibility for free and/or reduced lunch using school administrative records. Schools use verified household income to determine eligibility; cutoffs vary with household size and are on the order of 175% of the federal poverty level. Those families who were persistently eligible for free or reduced lunch across all years for which administrative data is available (2009–2016) are classified as economically disadvantaged (36.6% of the sample). Information on the frequency of technology use for members of these different demographic groups can be found in Jensen et al., (2019). As described above, key demographic covariates are included in all analyses to control for potential confounding of associations.

Adolescents reported daily in the evening on whether they attended school that day (0=attended school, 1= no school). This daily *school attendance* covariate is included in multilevel models to account for potential weekend effects (Przybylski & Weinstein, 2017) and third variable confounding (i.e. adolescents may report different levels of digital technology use and offline parent-adolescent interactions during unstructured time on non-school days). A person-mean of school attendance was computed across the study and reflects the percentage of days school was not attended (higher= more days out of school) and is included as a level 2 covariate to account for summer and school break seasonality (i.e. in summer a student would report 100% days off school). An indicator of *study day* (range 0–14, centered at day 7) was also computed and included as a level 1 covariate in all multilevel models to account for the ordering of daily observations.

Baseline Family Relationships.—Adolescents answered questions on several facets of their home environments. They responded to six items tapping the level of *chaos* and disorganization in the home (Matheny Jr et al., 1995; e.g. "it's a real zoo in our home", "we have a regular morning routine at home" (reverse scored)). Household chaos has been consistently shown to relate to the following features of parent-child relationships: more conflict, less closeness, less supportive parenting, less positive parenting, more negative parenting, less parental responsiveness, and less effective parental discipline (Marsh, Dobson, & Maddison, 2020). *Parent knowledge* was assessed as a mean of 5 items (Fletcher, Steinberg, & Williams-Wheeler, 2004) tapping parental monitoring activities (e.g. "how much do your parents try to know… who you spend time with", "…where you go right after school"; response options ranged from 0= 'they don't try' to 2= 'they try a lot'). They also

rated whether they have ever had an experience in which their online social networking site activities resulted in an *offline problem with their parents* (with a score of 1 indicating the lifetime occurrence of such an event; Lenhart et al., 2011).

Baseline Technology Access and Use.—Adolescents answered questions adapted from the PEW Internet & American Life national surveys (Lenhart, Ling, Campbell, & Purcell, 2010) reporting on their *mobile phone ownership* (0=no, 1=yes) and *social media use frequency ("*How often do you use social networking sites like Facebook or Instagram? (0) I do not have social media, (1) less often then every few weeks, (2) every few weeks, (3) 1–2 days per week, (4) 3–5 days per week, (5) about once per day, (6) several times a day).

Daily Parent-Adolescent Offline Interactions.—During the EMA, adolescents reported daily (afternoon and evening) on the occurrence or absence of 6 different *parent hassles* (e.g. "argued with a parent", "parents were too nosy", "people at home were stressed") and 6 different *parent uplifts* (e.g. "had fun with my family", "parents were happy with me", "parents helped me"). Responses were dichotomized at the daily level to yield indicators of the presence (1) or absence (0) of parent hassles and parent uplifts that day. Person-means were computed by averaging these dichotomous daily measures from the EMA (thus person-means reflect the proportion of days on which adolescents experienced hassles and uplifts). Adolescents also reported once daily (evening) on the extent to which they spent *time communicating with close others* ("people you are close to") during the day; response options ranged from 1='not at all' to 5='often'. A person mean was computed by averaging the daily scores on time spent communicating with close others across the entire study period.

Daily Digital Technology Use.—Adolescents self-reported each evening for 14 consecutive days on multiple measures of digital technology use, including on the number of *text messages sent*. Outlying daily reports that exceeded 10,000 text messages (11 daily observations, or .002% of daily observations) were coded as missing. Adolescents also reported each evening on the number of hours they estimated they had spent using technology for the following purposes: *school work, communication* (online or on phone talking to others or sending messages), *entertainment* (browsing social media, watching videos, playing games), and *creating content* (posting on social media, creating videos, etc). Reports on these items which exceeded 24 hours daily were coded as missing (<.018% of daily observations). Time spent on technology for schoolwork, communication, entertainment, and creating content were summed to yield a measure of *total screen time* that day.

Data Analyses

Baseline Adolescent Survey Sample.—First, we first examined cross-sectional (Question 1) associations between adolescents' reported digital technology use and perceptions of parent-adolescent relationship factors collected during the Baseline (T1) Adolescent Survey sample (N=2104). The three family relationship factors (whether online experiences spilled over into offline problems with parents, family chaos, and parent knowledge) were regressed separately on phone ownership and social networking site use,

alongside demographic covariates of age, gender, economic disadvantage, and binary coded contrasty for race/ethnicity. This approach to Question 1 is comparable to that taken in much of the past research on this topic (with the addition of important covariates) and allows for comparison of results from these cross-sectional, between-person associations with the intensive longitudinal, within-person associations tested in Questions 2–3.

EMA subsample.—Question 2 was tested in the EMA subsample, which comprises 14 days of survey responses nested within 388 adolescent participants. We parsed within-person daily and between-person variation in multilevel contextual models (Hoffman and Stawski, 2009), leaving the daily technology use variables in uncentered (raw) form, while accounting for the difference in average technology use (across days). In contrast to a person-mean centering approach, this technique facilitates interpretation of daily technology use (level 1 predictors) in their natural metrics (number of text messages and hours) such that the zero point represents a day with no technology use, while still accounting for the fact that some adolescents use more or less technology than other adolescents overall. With this centering strategy, the level 1 association is the *within-person* association, revealing the difference in offline parent-adolescent interaction outcomes across high versus low digital technology use days for the average adolescent, and the level 2 association is the *contextual association*, revealing the difference in the effect of being a high digital technology use adolescent (the between-person association) and having a high digital technology use day (the within-person association).

Question 2.: We examined Q2 using two-level models:

Level 1:	$ParentAdolescentOfflineInteractions_{ij=}$	$\beta_{0j} + \beta_1(dTechnologyUse_{ij}) + \beta_2(dSchoolAttendance_{ij}) + \beta_3(dStudyDay_{ij}) + \varepsilon_{ij}$
Level 2:	$\beta_0 =$	$\gamma_{00} + \gamma_{01}(mTechnologyUse_j) + \gamma_{02}(mSchoolAttendance_j) + \gamma_{03}(Age_j) + \gamma_{04}(Gender_j) + \gamma_{05}(Disadvantage_j) + \gamma_{06}(Black_j) + \gamma_{07}(Hispanic_j) + \gamma_{08}(Other_j) + \upsilon_{0j}$

The three types of daily parent-adolescent offline interactions (parent hassles, parent uplifts, and time spent communicating with close others) were modeled separately. Level 1 modeled daily parent-adolescent interactions for day *i* and person *j* as a function of a person-specific intercept term (β_{0j}), daily Technology Use (β_1), school attendance that day ($\beta_{2;}$ 0=school day and 1= no school), study day ($\beta 3$), and a residual term (ε_{ij}). Level 2 modeled the person-specific intercept as a function of person-average Technology Use (γ_{01}), average school absences (γ_{02}; to account for summer and school break seasonality), person-level covariates (γ_{03-} γ_{08}), and a random person-specific error term (υ_{0j}). The binary nature of daily parent hassles and uplifts was modeled using multilevel logistic regression, estimating the Log Odds of reporting a parent hassle or uplift; hassles and uplifts models did not models include a level 1 residual term. Multilevel models are well-suited to our research questions, as they enable us to parse within-person daily and between-person variation in the associations between adolescent digital technology use and offline parent-adolescent interactions.

Finally, Question 3 was tested in cross-lagged multilevel models using person-mean centered variables for level 1 predictors. We regressed daily offline parent-adolescent exchanges and digital technology use on Day X on offline parent-adolescent exchanges and digital technology use on Day X-1 (a lag of 1 day; alongside the same-day school attendance and study day covariates).

All analyses were conducted in Mplus 8.1 (Muthén & Muthén, 2017) with the help of the R-package for Mplus Automation (Hallquist & Wiley, 2018) and MLR estimation to help account for non-normality. Missing data was accounted for in all models used Full Information Maximum Likelihood (FIML) at both level 1 (daily) and level 2 (persons). FIML is considered a state-of-the-art technique for handling missing data, with simulation studies showing that FIML tends to produce the most efficient and unbiased parameter estimates when compared to other missing data techniques (Arbuckle, 1996; Enders, 2001). Random slopes were not modeled due to non-convergence with binary outcomes. Given the large number of comparisons necessary to test 6 indicators of digital technology use predicting 3 facets of parent-adolescent offline interactions, the Benjamini Hochberg procedure for adjusted significance tests was utilized to manage the False Discovery Rate (FDR; Benjamini and Hochberg, 1995). Descriptive statistics for all study variables and intraclass correlations (ICCs) for daily variables are reported in Table 1.

Results

Question 1: Are adolescents growing up in homes characterized by more technology-related conflict with parents, chaos at home, and lower levels of parenting monitoring also using more digital technology?

Results from the Baseline Adolescent Survey (N=2104) can be found in Table 2, and demonstrate that, after controlling for key covariates of age, gender, race/ethnicity, and economic disadvantage, adolescents who owned their own phones did not report experiencing more family chaos (β=−.014) and were no more likely to have online experiences spillover into the offline parent-adolescent relationship (*OR*=1.008). Adolescent phone owners did report that their parents had higher levels of knowledge (β =.051), though this association was not significant once false discovery was accounted for. In contrast, adolescents who reported engaging more with social networking sites reported living in homes characterized by more family chaos (β=.083), having online experiences spillover into the offline parent-adolescent relationship (OR=1.151), and more parental knowledge (β =−.044; though this association did not meet the FDR-corrected significance level).

Question 2a: Do adolescents report worse offline parent-adolescent interactions on days when they use more versus less digital technology (daily linkages)?

During the EMA (N=388 adolescents across 5270 combined days), no evidence was found to support the idea that adolescents' daily digital technology use reduced positive offline parent-adolescent interactions or the amount of time they spent with those close to them. That is, we did not see reductions in daily parent uplifts or less time spent with close others, nor increases in parent hassles on days adolescents reported relatively more versus less digital technology use (β_1; Table 3).

Question 2b: Do adolescents with higher average daily technology use across the 14-day EMA period also report worse daily offline parent-adolescent interactions across the study period?

As seen in Table 3, adolescents' average daily technology use ($\gamma 01$) across the EMA period was not associated with average time spent with close others. This lack of association was also true for most indicators of technology use and parent uplifts, with one exception: youth who, on average, reported exchanging more text messages over the study period tended to report fewer parent uplifts overall (OR=.985). Youth who reported higher average levels of digital technology use for school work, communication, creating content, and total screen time over the study period also had a higher average likelihood of reported parent hassles (OR=1.14 to 1.37). Of note, only one of these five observed associations met FDR-corrected significance levels which accounted for multiple comparisons: Those youth who reported more time spent on technology for school work were also more likely to report a parent hassle on any given day.

Question 3. Do the associations tested in Question 2 persist to the next day?

As seen in Table 4, three types of technology use were associated with more next-day offline parent hassles: youth who self-reported time spent on technology for communication, entertainment, and total screen time on Day X-1 were more likely to report experiencing a next-day (Day X) parent-hassle (β's=.043 to .061). Furthermore, youth who reported spending more time on technology creating content were less likely to report experiencing a parent uplift on the subsequent day (β=−.040) and youth who reported exchanging more text messages reported less time spent with close others on the subsequent day (β=−.062). However, none of these five associations retained statistical significance when multiple comparisons were accounted for using FDR.

Discussion

This study examined whether the amount of time adolescents spend using digital technology is related to the reported quality of their relationships with their parents and the amount of time they spend with people they care about. Although there was some cross-sectional evidence suggesting that those youth who were more engaged with digital technologies tended to report more experiences of online problems spilling into the offline sphere, family chaos, and more frequent parent hassles, there was little robust support for the hypothesis that adolescents' daily digital technology use detracts from the quality of same-day or next-day parent-adolescent offline interactions or time spent with close others.

Among the more than 2000 adolescents who participated in the initial survey, we saw that social networking site use (but not mobile phone ownership) was associated with more reported spillover of online problems into the offline parent-adolescent relationship and family chaos. We also found that phone owners tended to report that their parents had more knowledge of their lives and engage in more monitoring, whereas those adolescents who used more social media reported that their parents had less knowledge (though these were fairly small associations that disappeared once false discovery rates were accounted for). In the EMA sample, we also saw that those adolescents who spent the most time overall on

digital technology for several purposes (over the entire two-week study period) were slightly more likely to report worse overall offline parent-adolescent interactions. However, notably, the only association which remained significant after accounting for multiple comparisons was that between time spent on technology for *school work* (the aspect of technology use over which youth likely have the least control and are the least motivated to seek out) and the likelihood of reporting parent hassles over the entire study period. These cross- sectional associations appear somewhat consistent with some prior results suggesting that media engagement is a source of conflict and discord (Common Sense Media, 2016; Lenhart et al., 2011), but, as ever, cause and effect are impossible to ascertain given the cross sectional nature of the data.

In intensive daily sampling of adolescent perceptions of their time use and experiences, delivered via smartphone, we saw little evidence to suggest that that the quantity of adolescents' daily technology use displaces or disrupts key features of the parent-adolescent relationship on a daily basis, as evidenced by a lack of association between same-day adolescent technology use with more perceived parent hassles, fewer parent uplifts, or less time spent with close others. There were some small and inconsistent associations observed between adolescents' reports of technology use and next-day offline parent-adolescent interactions (with standardized regression coefficients ranging of about .04 to .06), though all of these associations disappeared once FDR-corrections were applied (and thus cannot be interpreted as evidence of a confirmed hypothesis). Null findings are consistent with earlier studies which found no associations between the quantity of technology use among adolescents and parent-adolescent relationship quality (Lee, 2009; Willoughby, 2008). These findings also correspond with reports from the growing majority of parents and youth in the United States who report that digital technology does not impact their relationships (Common Sense Media, 2016) and our own findings in this same sample (Jensen et al., 2019) which failed to find linkages between quantity of technology use and adolescents' mental health symptoms.

These results highlight the importance of avoiding the ecological fallacy and generalizing from between-person correlational studies to within-person processes. It is important to keep in mind that none of the daily or next-day associations tested met criteria for statistical significance once multiple comparisons were accounted for, and thus the small associations observed may be false positives (type 1 errors) and should be interpreted cautiously. Thus, while fears regarding the impacts of smartphones and social media on adolescents' relationships and health remain high in public and policy circles (Bell, Bishop, & Przybylski, 2015; Twenge, 2017; UK Commons Select Committee, 2017), evidence from daily, longitudinal (Heffer, Good, Daly, MacDonell, & Willoughby, 2019), and large scale cohort studies (Orben & Przybylski, 2019a, 2019b) does not yet support these concerns.

Conclusion

The present study leveraged intensive longitudinal data to better understand parent-adolescent relationships in today's digitally connected world. We found little evidence that more daily technology use was consistently associated with worse parent-adolescent offline

interactions, nor that time spent on technology was displacing time that young adolescents would otherwise be spending in in-person interactions with close others.

The utilization of in-the-moment EMA allowed for daily estimates of event occurrence and time allocation, and offered a number of advantages over typical retrospective self-report. The study was further strengthened by the recruitment of a population representative sample of contemporary adolescents enrolled in public schools, with broad coverage across multiple indicators of risk. Despite these strengths, several limitations should be noted. First, in both our large population representative and smaller EMA sub-sample, the data are observational and do not allow for an estimation of causal impacts of more versus less digital technology use on parent-adolescent relationships. In addition, even with the intensive daily assessments gathered through the EMA, it was not possible to fully understand directionality and temporal precedence within a single day. Future research that integrates both experimental paradigms and more intensive within-day assessments is needed. Second, we provided smartphones to approximately half the sample for the two-week EMA and cannot rule out that the introduction of the device changed the technology usage patterns (or parent-adolescent relationships) among the participating adolescents and their parents. Third, although EMA data collection is known to reduce bias in reporting, adolescents reported on both their perceptions of their digital technology usage and their relationships with their parents; parents may have very different perspectives on both of these topics, and indeed our study is limited in its lack of parent report. Future research ought to include both objective measures of technology use (e.g., device logs, billing records, analysis of text content) and parent report of their own behaviors and parent-adolescent interactions in order to more fully understand the interplay between technology parent-child dynamics. Fourth and finally, the present study made sure to account for important demographic covariates that could have resulted in spurious or confounded observed associations between adolescent digital technology engagement and their perceptions of offline parent-adolescent relationships, but testing whether associations might vary by race/ethnicity, gender, age, or economic disadvantage in cross-level interactions was beyond the scope of the present study. Future research should consider whether certain subgroups of adolescents (e.g. girls, younger adolescents, economically disadvantaged adolescents) may be differentially susceptible to linkages between digital technology use and the quality of their family relationships.

Mobile technologies are increasingly being integrated into family life, and parents have many questions about potential negative impacts on the parent-adolescent relationship. These results suggest that, for the most part, adolescent time spent on technology does not seem to be taking away from the quantity or quality of in-person parent-adolescent interactions, though there is some evidence that adolescents growing up in families characterized by more chaos and technology-related conflict are more likely to be frequent users of social media. Perhaps the more interesting question is not whether mobile devices are disrupting or displacing parent-adolescent relationships during adolescence, but rather how parents and adolescents can best integrate mobile devices as additional resources to support positive parent-adolescent connections – online and offline – during early adolescence.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

EMA	Ecological Momentary Assessment

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Table 1

Sample Descriptive Statistics

	Mean	SD	% of Sample
Baseline Adolescent Survey in 2015 (N=2104)			
Baseline age	12.360	1.123	
Gender (% female			52.1%
Race/Ethnicity			
White			51.5%
Black/African American			22.8%
Hispanic/Latino			14.5%
Other			11.2%
Economic Disadvantage (% disadvantaged			36.6%
Technology Access and Use			
Owns Mobile Phone			67.0%
Social Media Use	2.860	2.423	
Family Relationships			
Family Chaos	2.215	0.643	
Parental Knowledge	1.712	0.321	
Online to Offline Problems with Parents			9.5%
EMA in 2016–2017 (N=388)			**ICC**
Age at EMA	13.374	1.144	
Daily School Absences	0.576	0.308	.302
Daily Digital Technology Use			
Texts Sent	46.88	160.307	.426
Tech for School Work (hours: mins)	0:47	1:10	.324
Tech for Communication (hours: mins)	1:20	1:59	.516
Tech for Entertainment (hours: mins)	1:49	1:42	.427
Tech for Creating Content (hours: mins)	0:22	0:41	.398
Total Screen Time (hours: mins)	4:10	3:51	.525
Daily Parent-Adolescent Offline Interactions			
Family Hassles (% of days)	0.182	0.217	.410
Family Uplifts (% of days)	0.746	0.291	.616
Time Spent with Close Others	2.951	0.870	.437

Table 2

Cross-Sectional Associations between Digital Technology Use and the Parent-Adolescent Relationship

	T1 Online to Offline Problems with Parents			T1 Family Chaos			T1 Parent Knowledge		
	b (SE)	*OR*	*p*	*b (SE)*	*β*	*p*	*b (SE)*	*β*	*p*
Phone Ownership	.008 (.179)	1.008	.963	−.020	−.014	.525	**.035 (.016)**	**.051**	**.032**
Age	**.265 (.065)***	**1.304**	**<.001**	**.048 (.013)***	**.084**	**<.001**	**−.016 (.006)**	**−.057**	**.012**
Female Gender	.232 (.153)	1.262	.130	**.065 (.028)**	**.050**	**.019**	.008 (.014)	.012	.570
Persistent Disadvantage	.123 (.178)	1.131	.489	**.220 (.032)***	**.165**	**<.001**	−.026 (.017)	−.039	.117
Black Race/Ethnicity	.211 (.191)	1.235	.269	−.047 (.036)	−.030	.195	.002 (.019)	.03	.911
Hispanic Race/Ethnicity	−.534 (.274)	.586	.052	−.004 (.043)	−.002	.928	−.021 (.022)	−.023	.334
Other Race/Ethnicity	−.245 (.275)	.782	.372	−.011 (.048)	−.005	.824	−.032 (.023)	−.032	.159
Social Networking Site Use	**.140 (.036)***	**1.151**	**<.001**	**.022 (.006)***	**.083**	**<.001**	**−.006 (.003)**	**−.044**	**.049**
Age	**.189 (.067)***	**1.208**	**.005**	**.032 (.013)**	**.057**	**.013**	−.008 (.006)	−.030	.186
Female Gender	.146 (.157)	1.157	.353	.049 (.028)	.038	.076	.014 (.014)	.021	.322
Persistent Disadvantage	.102 (.178)	1.107	.568	**.217 (.032)***	**.163**	**<.001**	−.027 (.017)	−.040	.106
Black Race/Ethnicity	.214 (.192)	1.238	.266	−.048 (.036)	−.031	.175	.005 (.019)	.006	.795
Hispanic Race/Ethnicity	−.493 (.278)	.611	.076	.004 (.043)	.002	.935	−.024 (.022)	−.027	.269
Other Race/Ethnicity	−.214 (.277)	.807	.439	−.004 (.048)	−.002	.926	−.035 (.023)	−.034	.131

Note. Associations from the Baseline Adolescent Survey (N=2104) between each domain of T1 (Baseline) digital technology use and each facet of the parent-adolescent relationship are tested in separate single level regression models along covariates of age, gender, economic disadvantage, and dummy coded race/ethnicity. Significant relations bolded.

*indicates coefficients which met FDR-corrected significance level.

Table 3

Multilevel Models of Daily Relationships between Technology Use and Parent-Adolescent Offline Interactions

	Parents Hassles			Parent Uplifts			Time Spent with Close Others		
	***b* (SE)**	***OR***	***p***	***b* (SE)**	***OR***	***p***	***b* (SE)**	***β***	***p***
Texts Sent (in 10s)									
Daily β_1	−.004 (.005)	.996	.444	−.005 (.005)	.995	.301	.001 (.001)	.023	.199
Person-mean slope $\gamma 01$	−.006 (.010)	.994	.589	**−.015 (.007)**	**.985**	**.036**	.002 (.002)	.034	.313
Tech for School Work									
Daily β_1	−.049 (.030)	.952	.104	.019 (.041)	1.019	.652	−.001(.012)	−.002	.934
Person-mean slope $\gamma 01$	***.242 (.076)**	**1.27**	**.001**	.186 (.161)	1.204	.249	.023 (.057)	.032	.685
Tech for Communication									
Daily β_1	−.021 (.028)	.980	.454	.016 (.043)	1.016	.706	−.001 (.014)	−.003	.936
Person-mean slope $\gamma 01$	**.132 (.064)**	**1.14**	**.040**	.007 (.099)	1.007	.943	−.014 (.024)	−.033	.564
Tech for Entertainment									
Daily β_1	−.051 (.028)	.951	.070	.013 (.039)	1.013	.738	−.015 (.014)	−.038	.297
Person-mean slope $\gamma 01$	.112 (.072)	1.12	.121	−.046 (.130)	.955	.723	−.028 (.027)	−.058	.291
Tech for Creating Content									
Daily β_1	−.125 (.073)	.882	.087	.027 (.059)	1.028	.645	.023 (.024)	.024	.340
Person-mean slope $\gamma 01$	**.312 (.157)**	**1.366**	**.048**	−.055 (.272)	.947	.839	.036 (.068)	.030	.595
Total Screen Time									
Daily β_1	−.031 (.016)	.970	.054	.012 (.026)	1.012	.648	−.003 (.007)	−.014	.707
Person-mean slope $\gamma 01$	**.090 (.037)**	**1.094**	**.015**	−.008 (.077)	.992	.914	−.004 (.013)	.830	.785

Note. 5270 daily observations, N=388. Associations between each type of technology use and each parent-adolescent offline interaction domain are tested in separate multilevel models alongside covariates of daily school attendance and day in study and person-level mean school attendance, age, gender, economic disadvantage, and dummy coded race/ethnicity. Significant relations bolded.

*indicates associations which met FDR-corrected significance levels. Raw regression coefficients (standard errors) reported. *OR*= Odds Ratio

Table 4

Next-Day Cross Lagged Multilevel Models of Associations between Daily Technology Use and Parent-Adolescent Offline Interactions

	Offline Parent-Adolescent Interactions								
	Parent Hassles			Parent Uplifts			Time Spent with Close Others		
Day X-1→Day X	***b* (SE)**	***β***	***P***	***b* (SE)**	***β***	***p***	***b* (SE)**	***β***	***p***
Texts Sent									
Texts Sent→Offline Interactions	−.003 (.005)	−.028	.606	−.007 (.005)	−.074	.164	**−.002 (.001)**	**−.062**	**.005**
Offline Interactions →Texts Sent	−.231 (2.233)	−.003	.917	−.267 (1.036)	−.004	.797	−.169 (.319)	−.009	.596
Tech for School Work									
Tech→ Offline Interactions	−.036 (.034)	−.022	.284	−.026 (.041)	−.015	.522	.004 (.012)	.005	.753
Offline Interactions →Tech	−.043 (.063)	−.010	.499	.082 (.073)	.019	.261	−.003 (.024)	−.002	.901
Tech for Communication									
Tech→ Offline Interactions	**.066 (.023)**	**.048**	**.005**	.015 (.029)	.010	.597	.004 (.010)	.007	.639
Offline Interactions →Tech	−.063 (.072)	−.012	.384	.136 (.104)	.027	.192	−.050 (.032)	−.028	.117
Tech for Entertainment									
Tech→ Offline Interactions	**.075 (.032)**	**.061**	**.021**	−.003 (.033)	−.003	.919	−.011 (.012)	−.020	.353
Offline Interactions →Tech	−.116 (.096)	−.020	.225	.104 (.102)	.018	.308	.038 (.058)	.019	.509
Tech for Creating Content									
Tech→ Offline Interactions	.035 (.051)	.012	.491	**−.120 (.049)**	**−.040**	**.014**	−.010 (.028)	−.008	.715
Offline Interactions →Tech	−.024 (.038)	−.009	.527	.013 (.039)	.005	.736	−.003 (.015)	−.004	.836
Total Screen Time									
Tech→ Offline Interactions	**.027 (.013)**	**.043**	**.038**	−.007 (.016)	−.011	.656	−.003 (.005)	−.013	.490
Offline Interactions →Tech	−.220 (.150)	−.020	.142	.348 (.218)	.032	.110	−.002 (.074)	−.001	.980

Note. 5270 daily observations, N=388. Associations between each type of daily technology use and each parent-adolescent offline interaction are tested in separate multilevel models with person-mean centered variables. Auto-regressive, same-day, and covariate (daily school attendance and day in study) associations modeled but not depicted. Significant relations bolded. No association met FDR-corrected significance level. Raw regression coefficients (standard errors) reported.