A DYNAMIC SYSTEMS APPROACH TO THE ROLE OF ELECTRONIC MEDIA IN PARENT-CHILD SYSTEM BEHAVIOR

by

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(Under the Direction of Niyantri Ravindran)

ABSTRACT

The current media technology landscape presents developmental challenges for adolescent youth and their parents. Adolescence is a time of fundamental neural and social change, resulting in increased need for novelty and autonomy. Digital media caters to adolescents' inclinations through stimulating leisure content and social utility. As a result, adolescent youth now spend a plurality of their time using digital media devices. However, changes in youth technology behavior, such as the emergence of social media and first-time smartphone ownership, inject novelty into parent-child relationships. At the same time, concerns regarding the negative impacts of media overuse on developmental outcomes contribute to tension between parents and youth over screen time boundaries. Yet, little is known regarding how this tension and novelty impacts relational dynamics in the parent-adolescent system. In the studies presented here, I attempt to address this gap. Study 1 presents a longitudinal study of nearly 12,000 youth testing whether early smartphone ownership contributes to parent-adolescent informant discrepancy regarding youth mental health across early adolescence. Results of this study suggest significant informant discrepancy emerged and continued in years subsequent to youth smartphone adoption. Study 2 presents multilevel model tests of daily associations between 15-year old

youth social and entertainment media use and parent-child interaction quality. Results of Study 2 suggest that digital media use was not related to parent-child interaction quality at this age. Conceptualizations and findings are interpreted considering a dynamic systems theory framework.

INDEX WORDS: Adolescence, Smartphones, Dynamic systems theory, Youth mental health, Parent-child relationships

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DEDICATION

To all the squirrels and the trees they climb.

Thus, saith the LORD, stand ye in the ways, and see, and ask for the old paths, where the good way is, and walk therein, and ye shall find rest for your souls. But they said, “We will not walk therein”.

Jeremiah 6:16

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Jesus Christ, who elevated the status of the child and the value of the one lost sheep.

The LORD my God, who ponders the heart and from whom all blessings flow.

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CHAPTER 1

INTRODUCTION AND OVERVIEW OF STUDIES

The proliferation of electronic media has led to the emergence of historically novel developmental contexts. As a result, youth and their families are presented with new developmental opportunities and challenges. On the one hand, families are presented with new ways to communicate and participate in joint leisure activities. On the other hand, new technologies can detract from interaction quality and communication in close relationships (Sbarra et al., 2019). In response, families show variability in their integration, culture, and boundaries regarding electronic use (Njoroge et al., 2013). Complexity in family-technology dynamics is compounded due to youths' changing media habits across socio-emotional developmental stages (Kontostoli et al., 2021). This becomes especially salient as youths progress through adolescence and increasingly engage with more socially oriented forms of electronic media (Rideout et al., 2022). Consequently, the role of electronic media use in adolescent-family interactions has attracted considerable attention in the developmental sciences (Kaye et al., 2020) and a nascent yet considerable body of research has emerged.

Adolescence

Adolescence is a period of profound neurobiological and social development. Youth during this period show an increasing desire to explore novelty and stimulation (Romer et al., 2017; Steinberg, 2008) coupled with growing autonomy from parents (Spear & Kulbok, 2004) and peer influence (Laursen & Veenstra, 2021). These psychosocial changes are rooted in early neural maturation in reward-relevant subcortical brain regions (Spear, 2013) in tandem with

hormonal changes associated with pubertal development (Forbes & Dahl, 2010). Concurrently, there is a notable trailing rate of maturation in prefrontal neurocircuitry resulting in a lagging capacity for self-regulation via executive control networks (Steinberg, 2010). From a developmental evolutionary perspective, this maturational rate discrepancy facilitates youths' motivation towards exploratory behaviors and promotes context-specific learning (Galván, 2013; Romer et al., 2017).

The increased availability of digital leisure options creates a developmental challenge in adolescence because of its addictive attributes (Yellowlees & Marks, 2007) and social components. Particularly, electronic media offers endless neural rewards and social activities during a period of increasing reliance on peer relationships (Roach, 2018) and need for stimulation alongside underdeveloped self-regulatory abilities (Steinberg, 2005). Moreover, this challenge is exacerbated as youth during adolescence typically experience a gradual relaxation of parental restrictions on screen time (Symons et al., 2017).

Adolescent media use habits

Empirical evidence suggests that the confluence of adolescent developmental changes results in high rates of electronic media use (Rideout et al., 2022). In fact, electronic media is the predominant adolescent leisure activity (Joshi et al., 2016) as youth spend a plurality of their waking time on screens. Excluding time spent on screens for school, youth have been shown to spend six hours per day on average using electronic media (Rideout et al., 2022). The overwhelming majority of this time is spent using social media with watching videos and playing video games as other main leisure activities (Alexander et al., 2024).

In addition to increased use of screens in general, the smartphone becomes an increasingly relevant developmental factor as youth often become smartphone owners in early

adolescence (Rideout & Robb, 2020). Indeed, by 14 years old youth spend on average five hours per day using their smartphone according to one large study using objective passive sensing apps for measuring screentime (Alexander et al., 2024). These levels of smartphone use are unprecedented, and smartphone addiction is a rising concern for today's adolescent youth (Erdem & Sezer Efe, 2022).

Smartphones might provide a unique distinct context from other forms of electronic media use for several reasons. First, they can be carried in pockets and are thus continuously present. For many, this means that virtually no face-to-face interaction occurs without the potential for interruptions from smartphone notifications. Further, their perpetual presence ensures that engagement with a smartphone is always an available alternative to engagement with those around them. Moreover, smartphone screens are smaller making them less practical for shared activities, such as joint video games and movies.

Adolescent-parent relationships

Parent-child relationships undergo substantial transformations during adolescence as the developmental need for autonomy intensifies (Laursen et al., 2017). Adolescents begin to explore their individual identities, leading to a reorganization of relational dynamics characterized by increased independence-seeking (Noom et al., 2001). This shift often results in a recalibration of the power balance within the relationship (Branje, 2018), with adolescents challenging parental authority more frequently. While these adjustments can be a source of conflict (Smetana, 1989), they also provide opportunities for the relationship to evolve into one marked by greater reciprocity and mutual respect (Laursen et al., 2017). Emotional closeness may fluctuate (Pinquart & Silbereisen, 2002), but adaptive families navigate this transition by fostering open communication and maintaining supportive, yet negotiable, boundaries (Branje, 2018). As the

parent-child dyad adjusts, the relationship tends to shift from one of unilateral control to a more egalitarian dynamic (Smetana & Rote, 2019), allowing for the adolescent's growing capacity for self-regulation and autonomous decision-making.

Despite the shifts in autonomy and independence during adolescence, the parent-adolescent relationship remains a critical foundation for positive youth development into adulthood (Raudino et al., 2013). Parental support continues to play a vital role in fostering emotional regulation, self-esteem, and resilience, even as adolescents seek greater independence (Bariola et al., 2011). Research highlights that a secure and supportive parent-adolescent relationship acts as a protective factor against risk behaviors, promoting mental health (Morris et al., 2017), academic success (Chen & Gregory, 2009), prosocial behavior (Yoo et al., 2013), and substance abuse (Piko & Kovács, 2010). Adolescents who perceive their parents as emotionally available and involved are more likely to develop secure attachment patterns (Flaherty & Sadler, 2011), which translate into healthier interpersonal relationships into adulthood (Fosco et al., 2012; Hair et al., 2008). Moreover, the guidance and modeling provided by parents continue to shape moral and value-based behavior development during these years (Smetana, 1999), laying the groundwork for responsible decision-making and long-term well-being (Moretti & Peled, 2004). Thus, even as the dynamics of the relationship shift, its importance as a source of emotional and social stability remains pivotal for healthy adult outcomes (Stafford et al., 2016).

Electronic media use effects on parent-adolescent relationship

The increasing ubiquity of electronic media has led to profound changes in communication patterns and the nature of interactions in close relationships, such as the parent-adolescent (Sbarra et al., 2019). When used constructively, digital tools can provide opportunities for parents and adolescents to connect, offering new ways to share experiences and maintain

closeness in a rapidly changing digital landscape (Devitt & Roker, 2009). However, while digital technologies have given adolescents new avenues for independence and socialization, they also introduce challenges, such as decreased face-to-face communication frequency and quality (Dwyer et al., 2018) and potential conflict over screen time (Matthes et al., 2021). Parents often struggle to regulate and monitor their children's media use, leading to tensions around privacy, boundaries, and control (Nielsen et al., 2019). Additionally, electronic media exposes adolescents to a broader range of influences that may compete with parental values presenting challenges to parents' attempt to facilitate moral development. Thus, while digital media offers potential benefits for connection, it may also introduce significant obstacles to parental goals. In response, these changing dynamics to the developmental landscape are attracting research attention to the roles and impacts of electronic media in parent-adolescent relationships. Although incipient, a growing body of knowledge is emerging (Knitter & Zemp, 2020).

Empirical evidence suggests that adolescents' electronic media use is associated with increased conflict and negative interactions within the parent-adolescent relationship (Carvalho et al., 2015). For example, higher levels of EM use correspond to more frequent conflicts between parents and adolescents (Zhang & Livingstone, 2019; Zickuhr & Madden, 2013). Similarly, 32% of teenagers report arguing with their parents about device usage on a daily basis, underscoring how pervasive this issue is in modern family life (Rideout et al., 2022). Such conflicts often center on disagreements regarding the appropriate amount of screen time, online safety, and balancing digital interactions with family obligations (Francis et al., 2021; Reid Chassiakos et al., 2016). The frequency of these disputes can exacerbate tensions and strain the parent-adolescent bond (Evans et al., 2011), contributing to an atmosphere of discord.

Study results also suggest that heavy electronic media use is linked to broader familial disruption. Adolescents who engage in higher levels of electronic media usage also report increased family chaos and more problematic interactions with their parents (Jensen et al., 2021). This aligns with findings that heavy social media users, particularly adolescent girls, are more likely to report negative relationships across various parent-child dyads (Sampasa-Kanyinga et al., 2020), with the exception of mother-son relationships (Sampasa-Kanyinga et al., 2020). Excessive electronic media use can disrupt the rhythm of family life, leading to miscommunications, reduced family cohesion, and increased stress. In some cases, parents may respond to their adolescent's electronic media use with more harshness and punitive measures, where increased internet use was associated with greater parental strictness and criticism, further damaging relational quality (Mesch, 2006).

In addition to heightening conflict, electronic media use has been linked to decreased parent-child engagement during adolescence. Some parents report that their children's EM use diminishes meaningful interactions, making it more difficult to maintain close relationships (Devitt & Roker, 2009). Adolescents who spend more time online tend to spend less time interacting with their parents (Lee, 2009; Mesch, 2006b). As screen time increasingly competes with opportunities for in-person communication, parents and adolescents may experience a decline in emotional connection and shared activities (Richards et al., 2010). Research also shows that internet use (Mesch, 2003), and particularly mobile phone use, can lead to reduced closeness between parents and children (Mesch, 2003; Moawad & Ebrahem, 2016). Adolescents attention can become deeply absorbed in the digital aspects of their identity (Granic et al., 2020), presenting a potential barrier for meaningful engagement with parents.

Parent-child discrepancy in reporting youth mental health is an important indicator for the parent-child relationship with ramifications for outcomes in adolescent development (De Los Reyes et al., 2010; Guion et al., 2009). However, whether electronic media use is related to such informant discrepancy in adolescence has yet to be tested. As the above-mentioned studies indicate, the widespread use of electronic media in adolescence poses significant challenges for maintaining strong parent-child ties in some families. Heightened conflict, reduced engagement, and diminished communication quality may all contribute to weakening the emotional bonds that are crucial for healthy development during these formative years. In turn, such contexts have been shown to contribute to heightened parent-child mental health reporting discrepancy (Van Roy et al., 2010).

Gaps and limitations in current literature

The existing literature examining the relationship between adolescent screen use and parent-child relationship functioning has notable gaps. First, current studies largely rely on cross-sectional research designs, which capture associations at a single point in time but do not provide insight into causal relationships or how these associations change over time. Without a longitudinal perspective, it remains unclear whether increased screen use precedes shifts in relationship quality or if pre-existing relationship dynamics contribute to changes in screen use patterns. This limitation highlights the need for studies that employ more sophisticated multi-wave methods and examine different timescales to capture the temporal dynamics of screen use and its effects on the parent-adolescent relationship.

Furthermore, much of the current research relies heavily on subjective reports of adolescent screen time, typically collected through self- or parent-reports (Kaye et al., 2020). These methods are vulnerable to recall bias and may not accurately reflect the amount or type of

screen use (Wade et al., 2021). With the growing availability of objective measures, such as passive sensing through tablet, computer, or smartphone applications, there is a pressing need to incorporate these tools to more accurately capture screen use behaviors. Using objective measures further enables researchers to more accurately differentiate between different types of screen activities (e.g., social media use, gaming, educational content) and their distinct associations with parent-child dynamic, increasing validity in such construct measurement.

Another significant gap is the lack of research focusing on proximal processes and shorter timescales. Most studies look at general associations over broad periods, neglecting the day-to-day fluctuations in screen use and parent-child interactions. Methods such as daily diaries or ecological momentary assessment can provide nuanced insights into how screen use is linked to momentary shifts in interaction quality. Understanding these micro-level processes would allow researchers to capture the immediate impact of screen use on interactions, ultimately offering a richer and more comprehensive picture of these complex dynamics. Addressing these gaps would pave the way for more precise and effective interventions aimed at fostering healthier parent-child relationships in the digital age.

Theoretical perspectives

The current changes in and around the parent-adolescent system due to electronic media ubiquity are historically unprecedented not only in kind and scale, but also in speed and acceleration. It is not simply that families must adapt to the new reality of a novel technology a single time, but the technologies themselves continuously evolve, along with the way people use them. In response, research in this area must apply theories that can handle such complex challenges regarding change. Dynamic systems theory is one such approach that brings non-linear change, nested time scales, and multiple levels of interacting system behavior together.

The parent-child system is dynamic (Granic, Dishion, et al., 2003) in that it self-organizes, changes, evolves, responds, and reorganizes. It is characterized by continuity and discontinuity of behavior and changes in parent-child interactions are often qualitative (Pincus, 2001). These and other aspects are insufficiently addressed with current approaches. Dynamic systems theory is a set of principles used to describe behavior and nonlinear change in patterns of interactions between components of complex systems (Thelen, 2005). These principles have been used in developmental science to assess change in dynamic systems (Fogel, 2011; Smith & Thelen, 1993; Thelen, 2005), including in family (Granic, Dishion, et al., 2003; Granic & Patterson, 2006) and parent-child (Granic et al., 2007; Hollenstein et al., 2016; Lichtwarck-Aschoff et al., 2009) studies. Yet, dynamic systems theory has not been applied to evaluate the role of electronic media in parent-child patterns of interactions.

Multiple levels of interacting systems

According to dynamic systems theory, a system is a unit of interacting components. System behavior is described in terms of the nature of interactions between these system components (Von Bertalanffy, 1973), which can themselves be conceptualized as lower level systems. In the case of parent-child interactions, the parent-child dyad is a system contained within the family system. Moreover, the parent and child components are themselves distinct systems, each comprising various neurobiological components. Alterations in components at any level of system abstraction are theorized to impact system behavior at other levels (i.e., higher or lower order structures; Thelen, 2005). For example, in the case of parent-child behavior, neurobiological development (e.g., cognitive maturation) alters the child system's behavior, which influences parent-child system behavior, which in turn impacts the family system, which then affects behavior in broader systems (e.g., extended family, neighborhood, school, church,

etc.). The reverse is true as well—higher order system behavior influences lower order system behavior. This overall process is referred to as *circular causality* (Thelen & Smith, 1994).

Self-organization and reorganization through feedback processes

Self-organization is a core principle in dynamic systems theory. Self-organization refers to processes by which *attractor states*, or stable patterns of interactions, emerge through *reciprocal* acts between system components (Granic, Dishion, et al., 2003). Dynamic systems theory is not simply concerned with quantifying change within a system, but also considers variability and stability of system behavior (Smith & Thelen, 1993). Self-organization is underlain by two primary mechanisms: positive and negative feedback (Thelen, 2005). Positive feedback is said to occur when variability in system behavior is amplified, which can lead to novelty. In contrast, negative feedback facilitates stability and continuity in system behavior around an attractor state. Multiple attractor states are assumed to be available to a system at any given time. Deeper attractor states are more stable in that they are more likely to emerge across contexts and are more resilient to disruption. On the other hand, weaker attractor states are less stable and less resistant to disruption (Granic, Dishion, et al., 2003).

Another key aspect of dynamic systems theory is its emphasis on nonlinear change. This is a unique advantage given developmental and family science processes are highly complex (Cicchetti & Rogosch, 2002) and characterizing change as linear is likely to obscure true causal relationships (Granic, 2005). Yet, most developmental research is based on linear assumptions and most research conclusions are derived using general linear model statistical techniques. In dynamic systems theory, change is often described as moving from one attractor state to another, which is called a *phase transition* (Hollenstein et al., 2013). Phase transitions are said to be a result of perturbations (Granic, Dishion, et al., 2003). Perturbations are fluctuations in any part of

the system and can originate internally (e.g., changes in child neurobiology, shift in someone's mood, etc.) or externally (e.g., a child receives a text message, a parent changes jobs). In turn, a change in any part of the system has the potential to change the behavior of the entire system. If a system exhibits a phase transition, that system is said to move from one attractor state and then *reorganize* into another attractor state (Granic, Dishion, et al., 2003).

Phase transitions are also notable because they are thought to be periods during which the system is especially vulnerable to disruption (Smith & Thelen, 1993). This is because stable patterns of interactions have not yet reorganized, and the predictability of the next attractor state is low. In turn, high levels of variability during these times provide a ripe context for novel patterns of interaction to emerge. In terms of developmental processes, phase transitions might be considered especially significant in determining developmental trajectories and outcomes.

Another notable feature of dynamic systems theory are the concepts of control and order parameters (Han & Lang, 2020). Control parameters are external continuous variables that have the potential to destabilize system behavior patterns (Granic, Dishion, et al., 2003). Cell phone notifications could be an example of a control variable for parent-child systems because they can interrupt interactions thus promoting discontinuity in behavior. Order parameters are variables internal to the system that capture the system's behavior and reduce its complexity. A movie could be an example of an order parameter if parents and children are watching the movie jointly with their attention synchronized.

Interdependence of time scales

Interdependence of time scales is also critical in dynamic systems theory (Granic, Dishion, et al., 2003). According to this principle, shorter-term system behavior resonates across broader timescales. In return, shorter timescales are themselves wrapped within broader

timescales. First, micro-time scales are short and occur on the moment-to-moment level (e.g., seconds to minutes) within a given context (Hollenstein et al., 2013). These include acts of engagement such as vocalizations, gestures, bids, responses, etcetera that are extended and reciprocated. When parents and their children are in proximity, that system is conceptualized to self-organize through these reciprocal acts. Mirco-scale interactions play out across various typical parent-child contexts, such as mealtime, bedtime, playtime, and conflicts. Micro processes can also be characterized via acts of disengagement as well where dyad members are distracted, unresponsive, or physically separate. In other words, non-interaction is considered a system behavior. Through a history of interacting, parent-dyad systems will have developed various attractor states that are available to them, which can vary across contexts. Repetitive system level behavior at this micro time scale accumulates, stabilizes, and forms the scaffolding of broader timescale behavior.

Next, meso refer to longer segments of time (Hollenstein et al., 2013), such as days to weeks or even months. This level is analogous to moods, which are longer-term compared to emotions but shorter than traits. Characterization of the parent-child system at the meso-level refers to persistent interaction functioning qualities that tend to be found across multiple contexts. For example, a dyad attractor state could be characterized by high levels of conflict and low levels of engagement throughout the course of a summer in middle childhood. Meso-level time scales could also be examined in terms of things like perceptions (e.g., trust, perceived relationship security), relationship satisfaction, affection, and roles. Finally, macro-time scales refer to longer timescales such as months, semesters, and years (Hollenstein et al., 2013). System level behavior at this scale is analogous to persistent moods or even traits when considering behavior across longer stretches of time. This micro-meso-macro heuristic is a useful

simplification, however in reality timescales are relative to one another and can often be difficult to delineate clearly.

The principles of dynamic systems theory described here have aided researchers in describing family level behavior in previous research (Granic, Dishion, et al., 2003). For example, Hollenstein et al. (2013) leveraged this approach to explain interdependence and change of family flexibility along multiple timescales. The following sections will explain ways dynamic systems theory can be applied to the role of electronic media technology in parent-child interactions along multiple timescales, making a case for its utility.

A dynamics systems approach to electronic media in family systems

The role of digital technologies in family relationships is challenging to investigate for multiple reasons. First, rather than representing a singular experience, electronic media provides different and evolving functions for individuals. In terms of relationships, it may be useful to distinguish between media in terms of its impact on stability. Here, the concept of order and control parameters could prove useful. First, we can conceptualize electronic media as both an order (i.e., internal variable that increases stability and decreases likelihood of a phase transition) or a control parameter (i.e., external variable that increases complexity and increases the likelihood of a phase transition), depending on the context. As an order parameter, joint activities such as movies and video games focus parent and child attention and stabilize the nature of their interactions for the duration of the activity. As a control parameter, text messages phone calls, emails, and other app notifications have the potential to disorder parent-child interactions (McDaniel, 2014). The importance of distinguishing between types of electronic media to analyze its effects on interactions has been identified before (Radesky et al., 2016). Considering this, a framework with functional terms based on stability impacts could be useful.

Attractor states is another dynamic systems concept that could fill conceptual gaps in electronic media and parent-child research that are not well addressed in current research. There is heterogeneity in the ways dyads integrate electronic media (Lev & Elias, 2020) both within- and between-dyads. This variability has implications for conceptualizing system behavior. Within-dyads, some attractor states would be predicted to be deeper than others, and thus more resilient to the impacts of perturbations. This attractor state depth might vary according to the role of electronic media in respective states. Moreover, the depth of attractor states could change over time as a function of electronic media integration. Between-dyads, it is plausible that differences exist in the number and types of available attractor states between-dyads as well as the depths of those attractor states. Moreover, it might be informative to examine whether patterns of electronic media use can make some types of attractor states less available or unavailable to dyads. This would be especially important if precluded attractor states have qualities that are known to promote healthy youth development.

Previous parent-child studies leveraging dynamic systems theory have used a *state-space grids* method to conceptualize transitions between attractor states in parent-child systems (e.g., see Granic, Hollenstein, et al., 2003). This method has the advantage of capturing non-linear, qualitative changes in the parent-child relationship. Moreover, this can be used to capture variability in system level behavior across time, rather than simple linear changes in quantitative outcome variables (Granic, Hollenstein, et al., 2003). Moreover, this emphasis on variability as a variable of interest (i.e., both exogenously and endogenously) fits within current models of adversity that considers high unpredictability to be an adverse childhood context (Ellis et al., 2022).

Phase transitions is another area where DST might fruitfully intersect with developmental and family science research with regards to electronic media. As mentioned, phase transitions mark a period of change between attractor states and are characterized by system vulnerability to perturbations (Granic, Dishion, et al., 2003). Similarly, parent-child dyads are known in developmental science literature to undergo significant transitions resulting from the ebbs and flows of daily life as well as child development (Branje, 2018). This could be at the micro-level when dyads transition from, for example, mealtime to homework, school to home, or playtime to bedtime. Meso-level example transitions might include moving from the school year to summer schedule, from sport season to the offseason, or for youth who split time between separated parents' households, this could be the transition from one parent's household to the other. Last, macro-level examples include getting a cell phone, advancing from middle to high school, and developmental transitions, such as from early childhood to school-age or from childhood to adolescence.

Parents expend effort to maintain their vision of healthy parent-child relationship dynamics (Dixson et al., 2014). This might involve setting boundaries, monitoring children's behavior, positive and negative reinforcement, and a number of other parenting strategies. Continuity in character and expectations for parent-child systems across time and contexts is a primary challenge of the parent-child system, especially from a parent's goal-oriented point of view (Tamis-LeMonda et al., 2008). Transitionary periods represent vulnerability to external perturbations, both from a dynamic systems perspective and other developmental perspectives (McCubbin & Patterson, 2014). Thus, drawing from dynamic systems theory could be helpful for understanding discontinuity and how reorganization into maladaptive novel attractor states emerge, despite parents' efforts at continuity.

The universality of electronic media in daily life (Rideout et al., 2022) makes it central to how parent-child system processes unfold across youth development and dynamic systems theory could help to disentangle its various roles. For example, the adolescent transition is a period of profound change in neurobiological development, peer relationships, physical growth, and leisure activities (Steinberg, 2005). This is also the time when most youth become smartphone owners (Rideout et al., 2022). As an order parameter, electronic media might be leveraged to facilitate continuity. For example, texting enables parents and children to establish stability in communication as youth increasingly spend less time in the home and more time with peers. On the other hand, electronic media has the potential to further destabilize an inherently destabilizing developmental period. This may be especially true if boundaries are not well-established around electronic media use. Cell phone notifications have the potential to disrupt interactions between parents and children at any moment of the day. Moreover, video games, social media, and online streaming are in many forms individualized activities that are designed to be challenging to disengage from (Lozano-Blasco et al., 2022). These qualities may increase the likelihood that, during this phase transition, novel attractor states emerge in some families characterized by emotional distance between parents and children.

Boundaries, attitudes, and overall culture regarding electronic media use in parent-child systems is another research area that is gaining attention (Carvalho et al., 2015; Mollborn et al., 2022). Such environmental contexts could be considered order parameters because they are internal to the system and would tend to decrease its variability by increasing the likelihood of certain behaviors over others. Further, boundaries can be leveraged by parents to decrease the likelihood of self-organizing into a maladaptive or otherwise undesired attractor state. In other

words, effective boundaries may take some behaviors off the table, thus decreasing system complexity.

The emphasis on interacting nested timescales in dynamic systems theory is another are that is relevant for electronic media research. One theoretical gap left by current approaches is the overwhelming tendency for this field to view digital media effects as isolated within short windows (e.g., cross-sectional studies). For example, a study might test the effect of smartphone use by 13-year olds on their relationship quality with their parents. However, the role of a smartphone in the parent-13-year old system might vary based on the way the system self-organized around technology in the past. Some of these youth will have had their own tablet from early childhood, some will have had smartphones for 3 or 4 years, and some will have spent very little time with either. In dynamic systems terms, smartphone ownership at age 13 will represent a phase transition for some dyads, but not for others, potentially making quantitative differences in time spent on the phone qualitatively incomparable.

Overview of Studies

Study 1 Overview

The widespread adoption of smartphones among adolescents since 2007 has significantly altered the dynamics of parent-child interactions, raising concerns about its impact on family relationships and youths' mental health. By 2021, nearly 90% of teens aged 13-18 owned a smartphone (Rideout et al., 2022), facilitating extensive use of social media, gaming, and video content (Alexander et al., 2024). In dynamic systems theory terms, the introduction of the smartphone can be considered a perturbation to the parent-child system. As such, it would be expected that the system's behavior would necessarily exhibit discontinuity as it reorganizes into novel patterns of interacting. Research indicates that high levels of smartphone use can disrupt

face-to-face communication and reduce feelings of connectedness within families (Dwyer et al., 2018), potentially leading to degraded communication quality and decreased closeness between parents and their children (Sampasa-Kanyinga et al., 2020). These changes are occurring amid rising youth mental health concerns. Given these trends, there is growing need to determine whether heavy smartphone use exacerbates discrepancies between parent and child reports of the child's psychosocial health, as such reporting discrepancies have been linked to poorer outcomes (Reyes & Kazdin, 2006) and a reduce the likelihood for early intervention (Goolsby et al., 2018). This study aims to explore the role of adolescent smartphone use in contributing to parent-child reporting discrepancies regarding youth psychosocial health. Specifically, it examines whether high levels of smartphone use, particularly for activities like social media, reduce the likelihood that parents agree with their adolescent children regarding their mental health status. Understanding how smartphone use affects these discrepancies is crucial, as greater disagreement between parent and child reports can hinder timely intervention and support, potentially exacerbating existing mental health challenges during a critical developmental period.

Study 2 Overview

Adolescents now spend a considerable portion of their time engaged with electronic media, with social media and entertainment platforms being the most prevalent use case (Alexander et al., 2024). While prior research shows that higher levels of youth electronic media use are linked to strained family relationships (Carvalho et al., 2015), these studies have primarily focused on cross-sectional designs and lack insight into daily associations. This is a crucial research gap as family dynamics emerge according to proximal processes. Excessive media use may disrupt face-to-face interactions and reduce emotional bonding opportunities, but the impact of this disruption could vary depending on the closeness of the parent-child

relationship. Relationships characterized by greater closeness may be more resilient to the negative effects of high media use, while less close relationships may be more vulnerable. Therefore, the current study aims to examine the daily associations between different types of electronic media use and parent-child interaction quality and whether these relations are moderated by parent-child closeness.

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CHAPTER 2

THE ROLE OF SMARTPHONES IN PARENT-ADOLESCENT DISCREPANCY IN REPORTING EARLY ADOLESCENTS' MENTAL HEALTH PROBLEMS

1 Introduction

The release of the iPhone in 2007 marked a turning point in social interactions. Since then, adolescent smartphone ownership has steadily increased, with 43% of 8–12-year-olds and 88% of 13–18-year-olds owning smartphones by 2021 (Rideout & Robb, 2021). This rapid adoption has prompted research examining its impact on the parent-child relationship (Hawi & Samaha, 2017). Smartphone use can reduce face-to-face communication, fragment attention, and isolate one from their immediate physical and social environment (Dwyer et al., 2018). Empirical evidence suggests that smartphones can degrade communication quality and compromise functioning in close relationships (McDaniel, 2014; Sbarra et al., 2019). This impact on parent-child relationships may lead to fewer conversations about youths' mental health, potentially impacting parent and youth reporting agreement of youth internalizing problems (Kim et al., 2016; Robinson et al., 2019; Yang et al., 2021). Notably, early adolescence marks not only when smartphone ownership begins but also when internalizing problems, such as anxiety and depression, become more prevalent (Thapar et al., 2012). Moreover, meta-analyses indicate that parent-adolescent informant discrepancy is more pronounced for internalizing problems than other types psychopathology (De Los Reyes et al., 2015). Parents tend to underestimate youth-reported internalizing symptoms, as they are less observable and often rely on parental solicitation or youth disclosure for detection (Kapetanovic et al., 2020; Makol & Polo, 2018).

This raises the question: Does owning a smartphone in adolescence increase the likelihood of parent-child discrepancy in reporting internalizing problems? This is a critical concern because parents' awareness of their children's mental health is essential for timely intervention. Moreover, parent-child informant discrepancy is a known developmental risk factor, predisposing youth to impaired social functioning and mental health problems (Castagna et al., 2021; Fabris et al., 2020; Goolsby et al., 2018; Koca & Saatçı, 2022). Therefore, the present study aimed to examine the role of adolescent smartphone ownership in parent-child reporting discrepancy of youth internalizing problems.

1.1 Smartphones in adolescence

Youth typically become smartphone owners between the age of 8 (31%) and 14 (72%) according to Rideout et al. (2022). Smartphones present adolescents with a unique developmental challenge. Neurobiologically, they experience significant changes that lead to increased novelty-seeking and risk-taking (Steinberg, 2007), more autonomy from parents (Spear & Kulbok, 2004), and greater reliance on peers for social support (Farley & Kim-Spoon, 2014). At the same time, they experience trailing development in prefrontal brain regions that support executive control and emotion regulation (Romer et al., 2017). Concurrently, various addiction (Poudel & Gautam, 2017) and mental health problems (Thapar et al., 2012) tend to first emerge in adolescence as youth renegotiate their place among their peers and the broader social milieu. Amidst this sociobiological backdrop, smartphones present endless opportunities for social and entertainment stimulation. Further increasing their appeal, tech platforms present content through smartphone apps that are algorithmically designed to maximize the capture of users' attention. Consequently, these smartphone qualities can negatively impact close relationships (Sbarra et al.,

2019), potentially interfering with parental detection of fluctuations in their youths' mental health status.

1.2 Parent-child discrepancy in reporting adolescent psychosocial health problems

Using multiple informant methods to measure youth mental health is recognized as a strength in research and clinical practices (De Los Reyes et al., 2015). This is because parents and children sometimes report different yet valid information based on their unique perspectives (Karver, 2006). However, empirical studies suggest the concordance between parent's and child's reports are typically low to moderate in adolescence across a range of psychosocial outcomes (Rescorla, 2016). Low rates of agreement partly reflect excessive reporting discrepancy and may indicate parents' lack of awareness of their children's mental health status (Aebi et al., 2017; Lagattuta et al., 2012). Moreover, parents' sensitivity to their children's changing mental health is important for making remedial adjustments within the family and seeking early intervention (Goolsby et al., 2018) and greater informant discrepancy has been identified as a risk-factor for youth well-being (Castagna et al., 2021).

Various contributing factors to higher parent-child reporting discrepancy have been identified (Kolko & Kazdin, 1993; Treutler & Epkins, 2003), including relationship quality (Kim et al., 2016; Robinson et al., 2019; Yang et al., 2021). For example, poorer parental engagement (Van Roy et al., 2010), less communication (Barker et al., 2007; Van Roy et al., 2010), weaker maternal bonding (Chen et al., 2017), and lower parental monitoring (Laird & LaFleur, 2016) have been associated with stronger disagreement. Further, qualitative studies suggest that discrepancy can emerge when parents are unaware of adolescents' symptoms or misread their behavior (Bidaut-Russell et al., 1995).

1.3 Smartphones and parent-child discrepancy

Smartphones have the potential to negatively impact the quality of interactions in close relationships (Sbarra et al., 2019), including in the parent-child dyad (Stockdale et al., 2018). As adolescents increasingly spend time with smartphones, face-to-face interactions can degrade in frequency and quality within the home (McDaniel, 2014) and feelings of being distant increase between parents and youth (Lanette, 2018). In fact, the mere presence of a smartphone has been shown to decrease feelings of connectedness between individuals in proximity (Misra et al., 2016; Przybylski & Weinstein, 2013). Moreover, Davis et al. (2019) found evidence supporting the theory that excessive adolescent smartphone use contributes to parent-teen disconnectedness.

Given the impact of smartphones on close relationships, youths' access to smartphones may contribute to informant discrepancy in reporting internalizing problems between parents and adolescents. Smartphones have been shown to possess addictive qualities that capture youths' attention (Yildirim Demirdöğen et al., 2024), potentially reducing the frequency and quality of parent-child interactions. Reduced engagement provides fewer opportunities for parental solicitation and observation of affective cues. Moreover, even during interactions, smartphone use may fragment attention and diminish interaction quality (Lanette, 2018), further limiting parents' ability to perceive mental health cues. Consequently, adolescents' preoccupation with smartphones may hinder parents' awareness of their children's internalizing problems.

Smartphone use may also decrease adolescents' disclosure of mental health concerns to their parents. Social media, the most prominent smartphone activity, accounts for more than twice the daily usage time compared to other activities (Alexander et al., 2024). By expanding the peer social environment beyond schools, extracurricular activities, and social outings to virtually all locations, including the home, social media blurs the boundaries between peer

interactions and family time. Previously, adolescents could separate socializing with peers from debriefing with parents at home. Now, they carry their entire social network in their pockets (Kushlev et al., 2019). This constant access enables adolescents to share emotional burdens with peers at any time of day. Although peer support has its benefits, unrestricted access to peer networks may reduce adolescents' reliance on parental support, leaving parents less informed about their child's mental health and the contextual factors influencing it.

Youth are acquiring smartphones at increasingly younger ages, and early smartphone ownership has been linked to a range of maladaptive developmental outcomes (Sapien Lab, 2023). Given evidence that smartphones can disrupt close relationships (Lanette, 2018; Sbarra et al., 2019), early smartphone ownership may contribute to parent-child informant discrepancy regarding youth internalizing problems. Specifically, earlier smartphone adoption could influence parent-child relational dynamics during a period of heightened psychological vulnerability due to normative developmental changes. Therefore, it is essential to investigate whether early smartphone ownership is associated with parent-child discrepancy in reporting youth internalizing problems across early adolescence.

1.4 The current study

Smartphones can diminish the frequency and quality of interactions in close relationships (Sbarra et al., 2019), potentially limiting opportunities for child disclosure and parental solicitation of mental health concerns. This could increase parent-child reporting discrepancy of youth internalizing problems. However, the role of early smartphone ownership in parent-child informant discrepancy has not yet been examined. To address this gap, we use a multilevel framework to analyze smartphone ownership age and parent- and child-reported internalizing problems using data from the ABCD Study (Y1: M_{age} = 10.9, Y2: M_{age} = 10.9, Y3: M_{age} = 12.9

Y4: M_{age} = 14.1). This approach is recommended for modeling longitudinal informant discrepancy as an outcome (De Los Reyes et al., 2016) as it addresses the limitations of difference scores analyses (see Edwards, 1994; Laird & LaFleur, 2016 for review). First, we will test whether overall parent-child reporting discrepancy of youth internalizing problems (i.e., averaged across all time points) varies by age of smartphone ownership across early adolescence after controlling for parental education, youth biological sex, stage of pubertal development, and overall screen time. We hypothesize that discrepancy, such that parents underestimate youths' internalizing problems, will be higher with earlier smartphones ownership. Second, we will examine changes in informant discrepancy over time based on youth smartphone ownership age. We hypothesize there will be a significant moderating effect of time on informant discrepancy among youth who own smartphones. Further, we hypothesize that the informant effects will be more pronounced in each group for the measurement occasions after youth receive a smartphone. If supported, this would suggest that smartphone ownership contributes to increasing parent-child reporting discrepancy across early adolescence implying smartphone impacts on parent-child relationship dynamics. Last, in a Year 4 subsample who were observed using a passive sensing smartphone app, we test whether smartphone use levels impact parent-child informant agreement. We hypothesize that informant discrepancy will increase at higher levels of youth smartphone use.

2 Method

We used data from the Adolescent Brain Cognitive Development (ABCD) study to address study aims. The ABCD study recruited nearly 11,876 adolescents aged 9-10 at baseline beginning in 2015 with follow-up data collection planned every 6 months for a total of 10 years. Overall, data collected consists of neuroimaging, cognitive-tasks, and survey data.

2.1 Participants

For the current study, survey data were used from the one-year follow-up (Y1: N = 11,876; M_{age} = 10.9), two-year follow-up (Y2: N = 11,219; M_{age} = 12.0), three-year follow-up (Y3: N = 10,0972; M_{age} = 12.9), and four-year follow-up (Y4: N = 10,335; M_{age} = 14.1). The sample was designed to be a representative sample of US adolescents (White = 52.0%, Hispanic = 20.3%, Black = 15.0%, Asian = 2.1%, Other = 10.5%; Female = 47.8%).

2.2 Measures

2.2.1 Age of smartphone ownership

Parents were asked several questions regarding their child's smartphone ownership. First, they were asked whether or not their child owns a smartphone. If parents responded "No" to this item at Y4, then youth were assigned a value of "5" representing no smartphone ownership. In addition, parents were asked annually at what age did their children first own a cell phone. If answers changed throughout the study, then the earlier response was used. Then, smartphone ownership data was recoded according to the following categories: 8 & under = 1, 9 & 10 = 2, 11 & 12 = 3, and 13 & 14 = 4.

2.2.3 Child behavior problems (parent- and youth-reported)

Behavior problems will be reported by parents using the 112-item Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1991) and by youth using the 18-item Brief Problem Monitor (BPM; Achenbach et al., 2011), which is a companion to the CBCL. CBCL items will be limited to those items that are also present in the BPM. These measures feature composite scores for internalizing, externalizing, and attention problems. The current study will use the six questions from each survey that target internalizing problems.

2.2.4 Smartphone activity

Objective smartphone activity was measured in a subsample of youth (n = 1,463) using the Ksana Effortless Assessment Research System (EARS) app adapted for the ABCD Study. Data were collected during the Year 4 follow-up between September 2019 through January 2021. Participants with compatible mobile devices (Android OS version 6 or newer and iPhone 7 Plus or newer) were instructed to download the ABCD-EARS app research assistants. For iPhone and Android users, the EARS app recorded keystroke data. This was triggered whenever a participant entered a keystroke to record the following: The current open application, the application's category in the app store (e.g., entertainment, games, social media, etc.), the number of keystrokes struck, and the open and close time for the keyboard. For Android users, the EARS app additionally recorded smartphone application use by logging event times each time an app was opened, closed, and minimized. More detailed descriptions of EARS implementation in the ABCD Study have been described elsewhere (Alexander et al., 2024; Wade et al., 2021).

Due to asymmetry in application categorization across Google Play and the Apple App Store, the ABCD Novel Technologies Workgroup designed a process to harmonize keyboard data categories across platforms. Categories used for the current study include entertainment (iPhone: Entertainment, Android: Comics + entertainment + events), Social (iPhone: Social networking, Android: Communications + dating + social), Gaming (iPhone: Games + kids, Android: Action + adventure + arcade + board + card + casino + educational + music + puzzle + racing + role playing + simulation + sports + strategy + trivia + word) as well as total usage across categories (Alexander et al., 2024).

2.2.5 Covariates

Parental education and youth biological sex were included as between-level control variables. Further, the effects of pubertal development and overall screentime were modeled at the within-level as time-varying covariates as well as at the between-level by regressing overall internalizing problems on the respective person-level means.

2.3 Analytic Plan

All study analyses were conducted using Mplus version 8.3. Missing data was handled using full information maximum likelihood with robust standard errors (MLR) estimation because it produces unbiased parameter estimates with non-normal data (Yuan & Bentler, 2000). Missing data for internalizing problems ranged from 11.0% at Y1 to 21.3% at Y4. First, means and correlations among study variables were examined to assess overall sample characteristics and bivariate associations at each time point.

Next, we conducted a series of tests to examine whether parent-child informant discrepancy in youth internalizing problems varied across groups based on age of youth smartphone ownership. Empirical studies often use $X - Y$ difference scores (e.g., simple, absolute, standardized) to evaluate reporting discrepancies. However, a number of critiques have criticized the validity of this approach (Laird & De Los Reyes, 2013). For example, if reporters demonstrate unequal variance across the sample (e.g., parents vs. youth), then the results are driven primarily by the reporter with more variability (Edwards, 1994). Moreover, difference scores often artificially reduce variance compared to their components which can reduce statistical power. Second, because they are a composite of two values they inherit the accumulation of measurement error from both values, decreasing reliability (Edwards, 1994). Third, difference scores introduce ambiguity when interpreting effects because the same difference score can result from various combinations of X and Y (Laird & De Los Reyes, 2013).

As an alternative, polynomial regression (i.e., for cross-sectional models) and multi-level modeling (i.e., for longitudinal models) have been shown to be superior and were used in the current study as described in the following paragraphs.

Longitudinal multi-group models were tested based on the age of smartphone ownership to determine whether parent-child reporting discrepancies across time vary by the age in which youth first acquire a smartphone. We used multi-level modeling to distinguish between-dyad variance from within-dyad variance across time as was recommended by De Los Reyes et al. (2016). Behavior problems were modeled as the outcome variable with informant (i.e., child = 0 and parent = 1), Time, and the Time x Informant product modeled as predictors. In building the model, we first determined in the full sample whether fixed or random effects for Time and Informant provided the better fit using the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 2001). This test is used in place of the standard likelihood ratio test when MLR estimation is used due to the presence of non-normality. Then, in the first multi-group model, we tested the within-level direct effects of Time and Informant on internalizing problems. Pubertal development and overall screen time at each wave were included at the within-person level as a time-varying fixed effects while youth sex and parental education were included as time-invarying covariates at the between-level. Then, we added the Time x Informant product term at the within-level to test whether informant discrepancy changed across time. In this final model, β_{0i} represents the mean of child's internalizing problems when time is zero and the informant is the child, β_{1i} represents the effect of Time for individual *i* at time *j,* β_{2i} represents the effect of informant *k* on individual *i* (i.e., parent-child informant discrepancy), and β_{3i} represents the moderating effect of time *i* on the effect of informant *k* on internalizing problems. In this

model, observations are nested within individuals where time *j* and informant *k* are level 1 predictors.

Level 1:

$$\text{Internalizing Problems}_{ijk} = \beta_{0i} + \beta_{1i}(\text{Time}_{ij}) + \beta_{2i}(\text{Informant}_{k}) + \beta_{3i}(\text{Time}_{ij} \times \text{Informant}_{k}) + \epsilon_{ijk}$$

Level 2:

$$\beta_{0i} = \gamma_0 + u_{0i}$$
$$\beta_{1i} = \gamma_1 + u_{1i}$$
$$\beta_{2i} = \gamma_2 + u_{2i}$$
$$\beta_{3i} = \gamma_3 + u_{3i}$$

We will then probe the interaction to further examine how informant discrepancy changes across time for each group. Propensity weights provided by the ABCD Study will also be accounted for in all models to calibrate distributions to nationally representative controls based on the American Community survey to increase the generalizability of findings (see Heeringa & Berglund, 2020; Saragosa-Harris et al., 2022 for more information).

Finally, to examine the hypothesis that smartphone use levels impact parent-child reporting discrepancy, we will use polynomial regression analysis (Laird & De Los Reyes, 2013; Laird & LaFleur, 2016) to predict discrepancy as an outcome based on passive sensed youth smartphone data measured at T5. The polynomial regression formula will test quantity of smartphone use as a predictor of youth and parent reporting discrepancy is shown below:

$$Y = b_0 + b_1P + B_2P^2 + b_3S + b_4S^2 + b_5SP + e$$

With youth-reported behavior problems as an outcome, this model concurrently tests the linear effects of parent-reported behavior problems (P, b_1) and smartphone use (S, b_3) as well as the interaction between these two predictors (SP, b_5). The inclusion of quadratic effects of P and S (b_2 and b_4, respectively) are recommended to account for potential nonlinear associations that may exist between predictors and the outcome (Edwards, 1994; Laird & LaFleur, 2016).

Moreover, the linear interaction (i.e., Smartphone use x Parent) tests whether parent-child reporting discrepancy varies by quantity of youth smartphone use. Post hoc probing if interaction terms via simple slopes will be conducted to reveal the nature of the interaction.

3 Results

3.1 Descriptive Statistics

Means, standard deviations, and correlations among study variables for the whole sample are displayed in Table 1. Parental education was positively correlated with age of cellphone ownership ($r = .23$, $p < .001$), indicating that youth with more educated parents tended to acquire smartphones at older ages. Girls generally obtained smartphones earlier than boys ($r = .07$, $p < .001$). Internalizing problems increased across the four measurement occasions, with youth consistently reporting higher levels than their parents at each time point.

Table 2 shows the size, proportional demographics, and mean internalizing problems for each cellphone age group. Most youth were in the 9&10 ($N = 2,641$) and 11&12 ($N = 5,037$) groups while less membership was found in the 8&under ($N = 677$), 13&14 ($N = 744$), and no phone ($N = 376$) groups. There were more girls in the early smartphone ownership groups (8 & under: 53% girls; 9-10 : 51% girls) but more boys in the remaining groups (11&12: 48% girls; 13&14: 39% girls; No Phone: 37% girls). Youth with parents who had higher education tended to be proportionally larger in groups in which youth began smartphone ownership later or did not yet own a smartphone.

For internalizing problems, youth reported higher levels of internalizing problems than parents at all time points, except for the No Phone group. Also, in each of these groups, youth reported higher levels of internalizing problems at each consecutive year. In contrast for youth

who did not own a smartphone, youth reported higher levels of internalizing problems at Y1 and Y4, parents and youth reported the same levels at Y2, and parents reported higher levels at Y3.

A post-hoc multi-group latent growth curve analysis (see Figure 1) revealed that youth-reported internalizing problems showed significant positive slopes over time in all groups with the exception of the No Phone group (8&under: b = .39, β = .29, SE = .12, p = .001; 9&10: b = .19, β = .29, SE = .02, p < .001; 11&12: b = .20, β = .32, SE = .02, p < .001; 13&14: b = .21, β = .39, SE = .06, p < .001; No Phone: b = -.05, β = -.09, SE = .04, p = .216). However, parent-reported internalizing problems showed significant negative slopes in the 8&under (b = -.07, β = -.24, SE = .03, p = .013) and No Phone (b = -.07, β = -.19, SE = .03, p = .044) groups, but non-significant growth in the remaining groups (9&10: b = .00, β = .01, SE = .01, p = .858; 11&12: b = .01, β = .02, SE = .02, p = .439; 13&14: b = -.02, β = -.06, SE = .02, p = .308). Further, within-time correlations between parent and child reports of internalizing problems increased across the three years in the full sample (Y1: r = .25, p < .001; Y2: r = .30, p < .001; Y3: r = .34, p < .001; Y4: r = .38, p < .001).

3.2 Multilevel parent-child reporting discrepancy of internalizing problems models

3.2.1 Full sample random and fixed effects comparison

The Satorra-Bentler scaled chi-square difference test was conducted to compare the fixed effects and random effects models of the full sample. The test showed that modeling random effects significantly improved the model over fixed effects ($\chi_{SB}^2(2) = 8753.51$, p < .001). After controlling for parent education, youth sex, and within-level pubertal development, there were significant effects of time (b = 0.04, SE = 0.01, p < .001) and informant (Youth = 0, Parent = 1; b = -0.47, SE = .02, p < .001) on internalizing problems across the full sample. This suggests that overall (i.e., parent- and self-reports collectively) internalizing problems increased across the

four-wave period and that youth reported higher levels on average. Further, there was a significant negative effect of the product between time and informant on internalizing problems (b = -0.211, SE = .042, p < .001), suggesting informant discrepancy increased with youth age across the whole sample.

3.2.2 Multigroup direct effects of time and informant on youth internalizing problems

Parameter estimates for the direct effects of time and informant on youth internalizing problems are presented in Table 3. For within-level covariate effects, total screen time was related to internalizing problems in the 8&under, 9&10, and 11&12 groups, but not in the 13&14 and No Phone groups. Moreover, pubertal development was related to internalizing problems in only the 9&10 group. For between-level covariate effects, girls reported significantly more overall internalizing problems in all groups, except for the No Phone group. Moreover, higher parent education was related to more overall internalizing problems in the 9&10 group and 11&12 groups, but not in the 8&under, 13&14, and No Phone groups. Further, mean person-level total screen time was related to more internalizing problems in all groups, except for 8&under.

Direct effects of time (i.e., wave of data collection) and informant (i.e., youth = 0 or parent = 1) are shown in Table 3 prior to adding the interaction (i.e., time x informant) to the model. Time was positively related to internalizing problems for all current cellphone ownership groups, though only significantly for 9&10 and 11&12 (8 & under: b = .03, SE = .03 p = .426; 9-10: b = .06, SE = .02, p = .002; 11-12: b = .09, SE = .01, p < .001, 13-14: b = .03, SE = .03, p = .276). This suggests that the combined average parent- and youth-reported internalizing problems increased across the 3-year period for all groups in which youth owned a smartphone. In contrast, a negative, non-significant association between time and internalizing problems was found in the No Phone group (b = -.09, SE = .05, p = .068).

For overall informant discrepancy, a pattern emerged in which the negative effect of informant (Youth = 0, Parent = 1) on average internalizing problems across all timepoints was increasingly more pronounced the earlier youth began smartphone ownership. This effect was significant for all groups (8 & under: b = -.85, SE = .08, p < .001; 9-10: b = -.68, SE = .04, p < .001; 11-12: b = -.44, SE = .17, p < .001; 13-14: b = -.27, SE = .03, p < .001), except for the No Phone group (b = -.04, SE = .06, p = .694). This result suggests that parents reported significantly fewer internalizing problems overall in their children than their children self-reported in all groups, except for in the No Phone group, indicating that reporting discrepancy increased as youth smartphone ownership age decreased. Post-hoc Wald Tests revealed that the informant effect was statistically different for the following comparisons: 9&10 vs. 11&12 ($\chi2(1) = 26.98$, p < .001); 11&12 vs. 13&14 ($\chi2(1) = 5.83$, p = .015); 13&14 vs. No Phone ($\chi2(1) = 3.93$, p = .040).

3.2.3 The moderating effect of time on informant discrepancy

Significant interaction (Time x Informant) effects on internalizing problems (see Table 3) were found for all groups except for the No Phone (8 & under: b = -.25, SE = .05, p < .001; 9-10: b = -.19, SE = .02, p < .001; 11-12: b = -.20, SE = .01, p < .001; 13-14: b = -.20, SE = .04, p < .001; No Phone: b = -.02, SE = .05, p < .001). These results suggest that parent-child reporting discrepancy increased across time groups where youth owned cell phones. Specifically, parents increasingly reported less youth internalizing problems than their children as participants progressed through the study in these groups. Probing the interaction (see Figure 2 and Table 4) effect in each group revealed there was significant negative informant discrepancy (Youth = 0, Parent = 1) for at all timepoints (Y1: M_{age} = 10.9, Y2: M_{age} = 10.9, Y3: M_{age} = 12.9 Y4: M_{age} = 14.1) for the 8&under and 9&10 groups. Then, informant discrepancy was significant at Y2-Y4

for the 11&12 group and at Y4 for the 13&14 group. Last, informant discrepancy was not significant at any timepoint for the No Phone group. These results suggest that negative informant discrepancy (i.e., parent-report underestimating youth-report) coincided with age of smartphone use and continued to increase in the years after youth received their first smartphone.

3.3 The effect of smartphone use on parent-child reporting discrepancy

We then explored whether youths' time spent using a smartphone was cross-sectionally associated with parent-child reporting discrepancy of youth internalizing problems at Y4 (i.e., age 13-14) using passive sensing data (see Table 4). Direct effects revealed that smartphone use and parent-reported internalizing problems were positively associated with youth-reported internalizing problems (smartphone: b = .19, SE = .07, p = .005; parent-report: b = .24, SE = .10, p = .013). In addition, a significant quadratic association effect found for smartphone use (b = -.10, SE = .02, p = .005), but not parent-reported internalizing problems (b = .04, SE = .03, p = .208). No significant interaction was found (b = -.04, SE = .04, p = .317). This suggests that the discrepancy between parent and child report of youth internalizing problems did not vary based on the amount of time youth spent using their smartphones.

4 Discussion

Parents navigate a historically novel and evolving digital context for raising early adolescent youth. A large portion of social interactions transition online as youth progress from childhood through adolescence, with implications for social development. Smartphones provide entertainment and social connectivity that align with adolescents' changing interests, making ownership highly desirable, especially as peers adopt them. Yet, time tested norms have yet to establish around youth smartphone access and the long-term impacts of early smartphone adoption are not well understood. Evidence is mixed regarding the impact of smartphone

ownership on youth mental health. Some report null effects, while others suggest there are mental health costs associated with smartphone use, particularly at higher levels. Regardless, early detection of diminished mental health is important for preventing further decline, and parents play a central role in this process. The current study provides early evidence that this early detection may be increasingly compromised in early adolescence as youth become smartphone owners at earlier ages, even after controlling for total screen use. First, it was more likely that parents underestimated their child's overall mental health problems across early adolescence at earlier ages of smartphone ownership. Then, we also found that this pattern of reporting discrepancy became more prevalent across time for smartphone owners, but not for those who did not own a smartphone. Moreover, parent-child informant discrepancy was statistically significant only in years after youth owned a smartphone.

Results supported our first hypothesis that average parent-child informant discrepancy (i.e., the direct effect of informant on overall internalizing problems) would be more pronounced among youth who acquired smartphones earlier. In all groups except the No Phone group, youth reported significantly higher internalizing problems than their parents. Moreover, informant discrepancy followed a pattern in which the effect was larger in groups characterized by earlier smartphone ownership, respectively. In contrast, no significant informant discrepancy was observed in the No Phone group. This finding suggests that parent-child reporting differences may have a trait-like component that is more pronounced in dyads where youth acquire smartphones earlier.

Smartphone ownership may serve as an indicator of youths' prior digital media use (i.e., prior to early adolescence), which could contribute to parent-child informant discrepancy. Some supporting evidence suggests digital media use impacts parent-child relationships, which, in turn,

influences informant discrepancy (Van Roy et al., 2010). For example, higher youth digital media use has been linked to poorer parent-child relationship quality (Sampasa-Kanyinga et al., 2020), lower attachment quality (Richards et al., 2010), and more reported relationship problems with their parents (Jensen et al., 2021). However, because this pattern persisted after controlling for overall screen time, digital media use alone is unlikely to explain the full effect. Alternatively, early smartphone ownership may reflect broader family technology habits, wherein parents who are heavy digital media users provide phones to their children at younger ages. Indeed, parental smartphone use has been associated with less responsiveness and sensitivity to their children (Abels et al., 2018; Kildare & Middlemiss, 2017). Additionally, family routines may play a role. for instance, youth who spend more time away from home may receive smartphones earlier for communication purposes, but reduced parent-child time could limit opportunities for parental monitoring of mental health. In this way, smartphones may be an indicator of broader family dynamics that influence informant discrepancy.

Consistent with our hypothesis, parent-child informant discrepancy such that parents underestimated youth-reported internalizing problems increased over time in all groups except the No Phone group, even after controlling for total screen time. Also in line with our hypothesis, significant informant discrepancy (i.e., a significant effect of informant on internalizing problems) emerged only after youth acquired a smartphone. Moreover, this discrepancy continued to increase at each subsequent timepoint following smartphone ownership. These findings suggest that group differences in informant discrepancy are linked to smartphone ownership.

Our results indicate that youth smartphone ownership may hinder parents' ability to detect internalizing problems. Several mechanisms could explain this effect. First, smartphones

may facilitate a shift in emotional disclosure from parents to peers. Adolescents primarily use smartphones for social media and texting (Alexander et al., 2024), granting them continuous access to an online social network that other media do not. As youth increasingly seek peer support during adolescence (Brown & Larson, 2009), smartphones enable youth to confide in peers at any time and place, possible reducing their frequency of disclosure to parents. In this way, smartphones may act as a barrier to parental awareness of youth mental health concerns.

Youth smartphone use may not only shift disclosure patterns but also influence the parent-child relationship more broadly, with implications for closeness and communication. At proximal time scales, smartphone use can disrupt interactions and shared activities through notifications and frequent checking (McDaniel, 2020). Additionally, parents often cite smartphones as a source of conflict when enforcing technology boundaries (Hattersley et al., 2009). Over time, these events may accumulate, altering the dynamics of the parent-child dyad. Furthermore, earlier smartphone ownership has been linked to greater aggressiveness and irritability (Thiagarajan & Newson, 2025), potentially making interactions more challenging and increasing friction in the relationship. As a result, reduced closeness may mediate the relationship between early smartphone ownership and informant discrepancy. If so, the effects of early smartphone adoption may extend beyond disclosure patterns to the broader parent-child relationship itself. Future research should examine whether smartphone ownership age contributes to long-term changes in parent-child dynamics.

Consistent with prior research, we found that most youth acquired their first smartphone by age 12, with few remaining without one by age 14. This underscores the normative role of smartphones in adolescent development and the importance of considering their impact during this stage. Additionally, we identified demographic differences in smartphone ownership trends.

Girls and youth with less-educated parents were more likely to acquire smartphones earlier. These findings align with prior research showing that girls use smartphones more frequently than boys (Twenge & Martin, 2020) and that parents with higher education levels tend to impose more digital media restrictions (Livingstone et al., 2015).

Although this study does not establish causality between smartphone ownership and internalizing problems, one notable trend warrants discussion. Across all smartphone-owning groups, youth who acquired smartphones earlier consistently reported higher levels of internalizing problems at each timepoint. This pattern suggests an underlying process linking smartphones and mental health in early adolescence. Several explanations are possible. Smartphone ownership may serve as a marker of an unmeasured factor, such as family or peer influences, that simultaneously promotes early smartphone adoption and increases mental health risk. Alternatively, it may reflect broader technology use patterns. Another possibility is that youth experiencing psychological distress advocate for smartphone ownership earlier, as prior research suggests increased screen use among individuals with depression, potentially as a coping mechanism (Elmquist & McLaughlin, 2018; Wolfers & Utz, 2022). Conversely, smartphone use itself may contribute to mental health risks (Twenge, 2020).

Our findings indicate that the No Phone group differed from smartphone users in several key ways. First, prior research consistently shows that parents report lower levels of internalizing problems than youth self-report (De Los Reyes et al., 2015). This pattern held across all groups except the No Phone group, where parent and child reports were more aligned. Second, latent growth analyses revealed that while internalizing problems significantly increased in all smartphone groups, they decreased over time in the No Phone group. Third, parent-reported internalizing problems were consistently higher in the No Phone group than in smartphone

groups. However, because parents of smartphone users tended to underestimate youth-reported internalizing problems, parent reports in the No Phone group were the most similar to youth self-reports. These findings suggest that the No Phone group may represent a distinct population. Research on this form of smartphone abstention is scarce and given that this group was a small minority in our sample, their divergence from the normative trend of early smartphone adoption warrants further investigation. Future studies should explore the family, peer, and individual factors associated with delaying smartphone ownership.

Limitations

These findings should be considered in light of several limitations. First, while we controlled for overall screen use at each timepoint, we could not account for the frequency of smartphone use throughout the study. Future research should examine how smartphone use, beyond mere ownership, influences parent-child informant discrepancy. Second, smartphone behaviors vary widely among youth. If primarily used for parental communication, smartphones might enhance rather than hinder parent-child agreement. Future studies should distinguish between different usage patterns to identify risks and benefits. Third, our focus was on informant discrepancy in internalizing problems. It remains unclear whether similar patterns extend to other constructs, such as externalizing behaviors or family dynamics. Fourth, parents retrospectively reported the age of smartphone acquisition, and internalizing problems were assessed at one-year intervals. Future research should measure smartphone adoption more precisely and examine informant discrepancy at shorter timescales before and after acquisition to capture more proximal effects. Finally, youth-reported internalizing problems were successively higher in groups with earlier smartphone ownership, making it difficult to disentangle informant discrepancy from overall group differences in mental health. However, our multilevel modeling approach accounts

for between- and within-person variance and mitigates such confounding issues inherent to difference scores (De Los Reyes et al., 2016; Laird & De Los Reyes, 2013). Nonetheless, future research should replicate these findings in clinical samples to further clarify these relationships.

Conclusion

Despite these limitations, our study leverages advanced statistical methods and a large, longitudinal, and generalizable dataset to examine parent-child informant discrepancy in youth internalizing problems. First, we found that overall discrepancy was more pronounced among youth who received smartphones earlier, suggesting that studies relying on parent-reported internalizing problems should account for youth smartphone ownership. Second, informant discrepancy increased over time among smartphone owners, highlighting a potential long-term effect of smartphone use on parent-child agreement regarding mental health. Finally, youth without smartphones exhibited distinct developmental patterns in internalizing problems based on both parent- and self-reports, underscoring the need for further research on this subgroup. Our findings provide important insights into the role of smartphone ownership in adolescent psychosocial development and suggest early smartphone ownership may lead to parents' underestimation of their children's internalizing problems in early adolescence.

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Table 1

Means, standard deviations, and correlations of study variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Internal (Y) 1	--										
2. Internal (Y) 2	.51***	--									
3. Internal (Y) 3	.40***	.58***	--								
4. Internal (Y) 4	.35***	.44***	.58***	--							
5. Internal (P) 1	.25***	.23***	.20***	.18***	--						
6. Internal (P) 2	.22***	.30***	.26***	.24***	.65***	--					
7. Internal (P) 3	.21***	.30***	.34***	.27***	.59***	.67***	--				
8. Internal (P) 4	.23***	.28***	.31***	.38***	.54***	.61***	.67***	--			
9. Youth sex	-.03*	-.15***	-.23***	-.29***	.00	-.04**	-.07***	-.14***	--		
10. Education (P)	-.09***	-.06***	-.03*	-.01	.06***	.08***	.09***	.08***	.01	--	
11. Cellphone age	-.04**	-.04**	-.07***	-.06***	.03**	.04**	.04**	.03	.07***	.23***	
M	1.74	1.81	2.02	2.27	1.49	1.43	1.46	1.48	.52	3.74	2.72
SD	2.11	2.23	2.38	2.56	1.88	1.88	1.93	1.96	.50	1.17	0.85

Note. Y = Youth-report, P = Parent-report, Internal = Internalizing problems. ***$p < .001$, **$p < .01$, *$p < .05$.

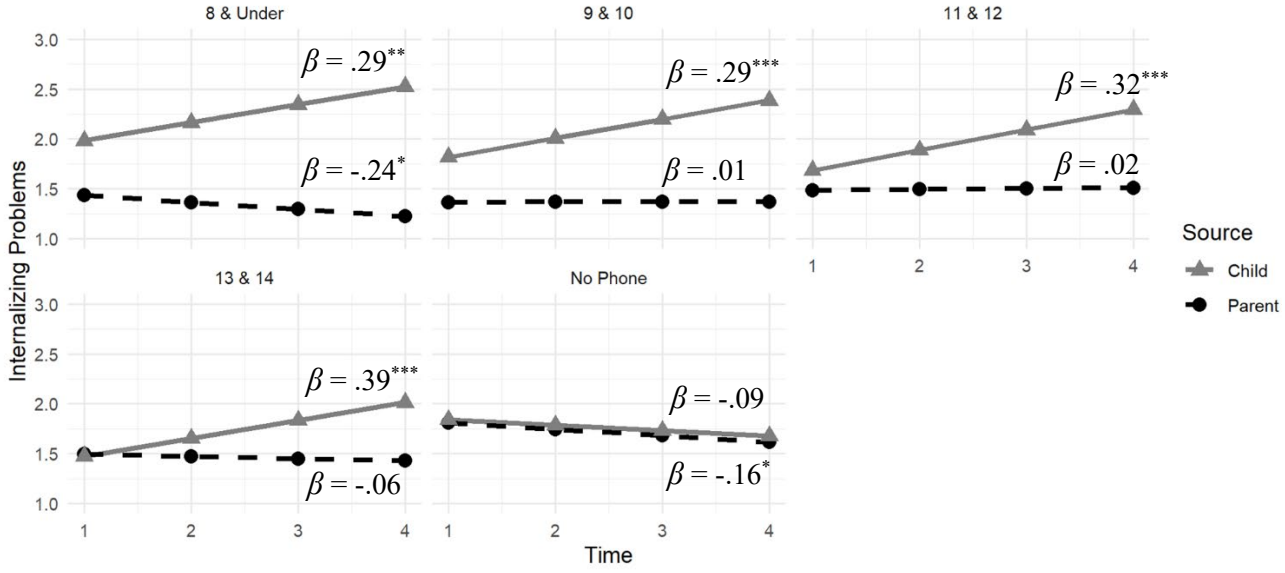
Table 2

Group means for internalizing problems across time and demographic covariates

	8 & under	**9&10**	**11&12**	**13&14**	**No phone**
N	677	2641	5037	744	376
	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**
Sex (0=F, 1=M)	.47(.50)	.49(.50)	.52(.50)	.61(.49)	.63(.49)
Parent education	3.06(1.10)	3.51(1.15)	3.89(1.13)	4.10(0.99)	4.19(1.01)
	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**
Youth Y1 (10-11)	2.03(2.23)	1.82(2.11)	1.71(2.11)	1.46(1.91)	1.85(2.23)
Youth Y2 (11-12)	2.05(2.43)	1.95(2.26)	1.79(2.21)	1.62(2.15)	1.80(2.31)
Youth Y3 (12-13)	2.36(2.56)	2.16(2.48)	2.07(2.40)	1.75(2.14)	1.50(1.96)
Youth Y4 (13-14)	2.56(2.72)	2.36(2.67)	2.31(2.57)	2.04(2.40)	1.82(2.17)
	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**
Parent Y1 (10-11)	1.49(2.00)	1.39(1.82)	1.52(1.87)	1.50(1.84)	1.75(2.00)
Parent Y2 (11-12)	1.30(1.94)	1.35(1.79)	1.45(1.88)	1.44(1.89)	1.80(2.21)
Parent Y3 (12-13)	1.34(1.99)	1.36(1.86)	1.52(1.99)	1.44(1.77)	1.72(2.14)
Parent Y4 (13-14)	1.31(1.81)	1.39(1.89)	1.54(2.01)	1.40(1.80)	1.60(2.21)

Figure 1

Multi-group latent growth curve analysis of parent- and child-reported youth internalizing problems by age of cell phone ownership



Note. ***$p < .001$, **$p < .01$, *$p < .05$.

Table 3

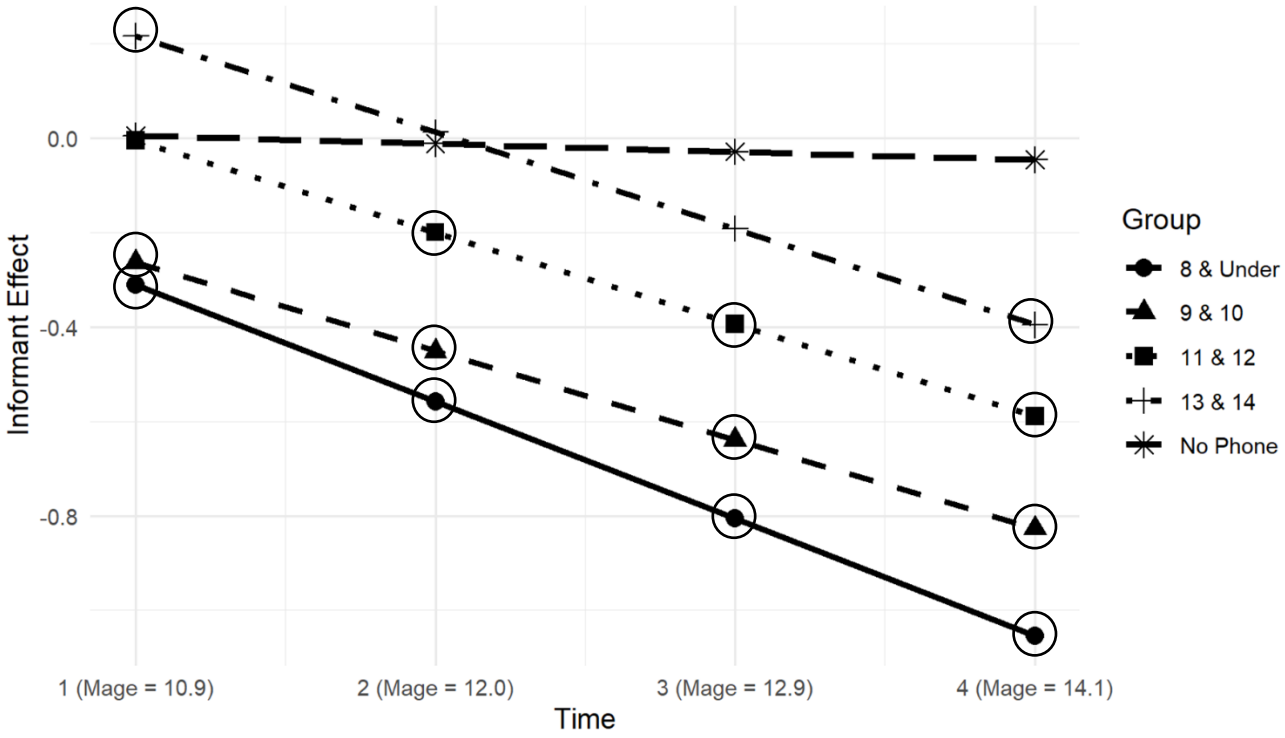
Parameter estimates for multilevel models examining the impact of time, informant, and time x informant on internalizing problems based on smartphone age of ownership group

	8 & under			9 & 10			11 & 12			13 & 14			No Phone		
Level 1	***Est***	***SE***	***p***	***Est***	***SE***	***p***	***Est***	***SE***	***p***	***Est***	***SE***	***p***	***Est***	***SE***	***p***
Covariates															
Puberty → IP	.08	.06	.179	.09	.03	<.001	.02	.02	.249	.08	.04	.073	.06	.07	.401
Screen time → IP	.05	.01	<.001	.02	.01	<.001	.03	.01	<.001	.02	.01	.051	.03	.02	.064
Random effects															
β_1 Time → IP	.03	.03	.426	.06	.02	.002	.09	.01	<.001	.03	.03	.276	.06	.07	.401
β_2 Informant → IP	-.85	.08	<.001	-.68	.04	<.001	-.44	.03	<.001	-.27	.06	<.001	.03	.02	.064
β_3 Time x Inf. → IP	-.25	.05	<.001	-.19	.02	<.001	-.20	.02	<.001	-.20	.04	<.001	-.02	.05	.747
Level 2	***Est***	***SE***	***p***	***Est***	***SE***	***p***	***Est***	***SE***	***p***	***Est***	***SE***	***p***	***Est***	***SE***	***p***
Covariates															
Youth sex → IP_{mean}	-.41	.15	.005	-.29	.07	<.001	-.32	.05	<.001	-.36	.13	.007	-.23	.22	.298
Pedu → IP_{mean}	.08	.05	.160	.11	.02	<.001	.09	.02	<.001	.08	.05	.112	.03	.07	.693
PD_{mean} → IP_{mean}	.02	.10	.868	.03	.04	.424	.10	.03	.002	.14	.09	.111	.04	.13	.780
ST_{mean} → IP_{mean}	.02	.02	.294	.06	.01	<.001	.12	.01	<.001	.13	.03	<.001	.09	.04	.037

Note. IP = Internalizing problems, Pedu = Parent's education, PD = Pubertal development, ST = Screen time.

Figure 2

Predicted values of informant effect by age of smartphone ownership group



Note. A negative informant effect indicates parent-report underestimated youth-report. Circled points indicate a statistically significant informant effect.

Table 4

Probe of the effect of the time x informant product on internalizing problems

		8&under			9&10			11&12			13 & 14			No Phone		
Year	M_{age}	*b*	z	*p*	*b*	z	*p*	*b*	z	*p*	*b*	z	*p*	*b*	z	*p*
1	10.9	-.31	-2.28	.023	-.26	-4.31	<.001	-.01	-.09	.901	.22	.22	.039	.01	.03	.973
2	12.0	-.56	-3.82	<.001	-.45	-6.61	<.001	-.20	-4.14	<.001	.01	.01	.904	-.01	-.06	.952
3	12.9	-.81	-4.67	<.001	-.64	-8.36	<.001	-.39	-6.98	<.001	-.19	-.19	.131	-.03	-.14	.892
4	14.1	-1.05	-5.04	<.001	-.83	-8.98	<.001	-.59	-8.66	<.001	-.40	.40	<.001	-.05	-.19	.848

Note. Mage = Mean age at measurement occasion. *b* = the effect of informant on internalizing problems. Significant effects indicate the informant effect is statistically nonzero.

CHAPTER 3

DAILY ASSOCIATIONS BETWEEN ADOLESCENT DIGITAL MEDIA USE AND PARENT-CHILD INTERACTION QUALITY

1 Introduction

Teenage youth now spend a plurality of their time with electronic media, primarily using social and entertainment platforms (Alexander et al., 2024). Beneath this mass adoption of digital media broadly, there are individual differences in the amount of time youth spend engaged in such activities. These differences have been empirically shown to be associated with interaction quality in close relationships (Sbarra et al., 2019), including the parent-child relationship (Carvalho et al., 2015). However, such studies tend to be methodologically limited to broader time scales and daily associations between youth digital media use and parent-child interaction quality are scarcely tested. This is a significant research gap as family level processes are dynamic and unfold at multiple levels of nested timescales (Dishion et al., 2012). Moreover, it is untested whether the daily association between youth electronic media use on daily interaction quality depends on the overall closeness between parents and children. The current study aims to address these gaps. First, we test the within-person associations between types of electronic media use and family functioning across seven days using daily diary data. Then, we examine whether this association is moderated by parent-child closeness.

1.1 Adolescent electronic media use and family relationships

Adolescent youth spend on average 5-6 hours per day using electronic media beyond educational activities (Rideout et al., 2022). The bulk of this time is spent using social media,

especially for girls (Twenge & Martin, 2020), followed by entertainment and gaming (Alexander et al., 2024). These high rates of electronic media usage in recent years have led to a range of changes in the nature of interactions in close relationships (Sbarra et al., 2019), such as within the family. On the one hand, electronic media offers benefits for families such as efficient ways to communicate (Devitt & Roker, 2009) and opportunities for joint leisure. On the other hand, excessive youth electronic media use has the potential to disrupt healthy patterns of family interactions (Carvalho et al., 2015).

Empirical evidence suggests excessive youth electronic media use can lead to strain on the parent-child relationship (Jensen et al., 2021). First, spending more time in individual digital media activities can diminish affective qualities between family members (Mesch, 2006) by limiting opportunities for meaningful communication and emotional bonding. Second, high levels of digital media use have been shown to compromise the quality of face-to-face interactions within the family (Dwyer et al., 2018; McDaniel, 2014; Tammisalo & Rotkirch, 2022). Third, disputes over digital media use boundaries have been documented as a primary point of contention in parent-child relationships (Evans et al., 2011; Reid Chassiakos et al., 2016), particularly when youth demonstrate screen addiction or problematic media use. This struggle over boundaries has been reported to normalize into a perennial source of contention and conflict (Francis et al., 2021).

While electronic media is often treated as a singular category, it encompasses various activities that can have distinct effects on family dynamics. Social media platforms, for example, involve interactive communication and networking with peers, which may influence adolescents' social development and alter parent-child interaction patterns differently than other media forms. In contrast, activities such as video gaming or streaming television and movies are typically

more entertainment-oriented experiences. These differences are significant because each type of digital media use may uniquely impact parent-child relationships. Therefore, it is crucial to consider specific types of electronic media when examining their effects on parent-child interaction quality. Yet, a lack of specificity in developmental research has been identified as a limitation in the existing digital media effects literature (Kaye et al., 2020).

Several factors suggest that socially oriented electronic media may have a stronger association with family conflict than other forms during early adolescence. First, while video games and video viewing are common activities throughout childhood (Rideout & Robb, 2020), adolescence often marks the onset of social media use for most youth (Pew Research Center, 2022). The introduction of social media brings new dynamics into the household, potentially leading to conflicts as families navigate setting new and evolving boundaries around privacy, screen time, and appropriate online behavior (Reid Chassiakos et al., 2016). Further, adolescents may be emotionally influenced by online social interactions which can affect their mood and behavior at home, leading to increased family tension.

There are also noteworthy differences in the way girls and boys engage socially online. Research indicates that girls are more likely than boys to use social media for relational purposes, place greater emphasis on peer relationships, and are more sensitive to online social feedback (Twenge & Martin, 2020; Rose & Rudolph, 2006). This heightened sensitivity can make them more vulnerable to the emotional ups and downs associated with online interactions, potentially exacerbating stress and conflict within the family. Additionally, girls tend to spend more time on social media platforms compared to boys, increasing the likelihood of disputes over screen time and online activities with parents (Rideout & Robb, 2020).

1.2 Considering different timescales

The preponderance studies that examine the relation between digital media use and the parent child relationship are methodologically limited to cross-sectional analyses of single time points (Carvalho et al., 2015). However, research guided by dynamic systems theory has shown that such family developmental processes occur at multiple nested and interacting timescales (Dishion et al., 2012; Granic et al., 2003). Therefore, tests of more proximal levels of analysis are critical for understanding the development of patterns of parent-child interactions. However, such examinations are scarcely attempted.

Few studies have tested daily associations between youth electronic media use and parent-child interaction quality. One exception is a study that used ecological momentary assessment over a 14-day period (Jensen et al., 2021). This study found that children who used more social media overall throughout the study period also reported higher levels of family chaos and problems in parental relationships. Moreover, there was some limited evidence that daily screen use was related to negative impacts on parent-adolescent interactions (Jensen et al., 2021). Specifically, they found that some types of screen use were related to more negative same day interactions with parents. Moreover, they also found that some forms of screen use were related to more negative, less positive, and fewer overall interactions with parents, the next day. However, due to the high quantity of statistical tests none of these significant daily associations remained after correcting for multiple comparisons (Jensen et al., 2021) and additional daily association studies are needed to clarify this area. Alternatively, it may be that this association depends on other relationship factors.

1.3 The moderating role of the adolescent-caregiver relationship

Prior research suggests that the strength of existing relationships can moderate the impact of electronic media use on family interactions (Haythornthwaite, 2002). Parent-child closeness,

characterized by strong behavioral and emotional connections, may serve as a protective factor against the potential negative effects of excessive digital media use. In relationships with high levels of closeness, open communication and mutual understanding can mitigate misunderstandings and conflicts that often arise from extensive media engagement. For example, parents and adolescents who share a close bond are more likely to effectively negotiate media use boundaries, reducing the likelihood of disputes. Consequently, families marked by a high degree of closeness may be more resilient to the detrimental impacts of heavy media use on interaction quality, while less close relationships may be more susceptible to these negative effects.

1.4 The current study

The current study investigates the daily associations between adolescents' digital media use and the quality of parent-child interactions over a seven-day period using a daily diary methodology. Specifically, we examine whether fluctuations in adolescents' use of social and entertainment media are linked to same day and next day variations in interaction quality with their parents. We hypothesize that more use of both social and entertainment digital media use will be related to worse parent-child interaction quality. Further, we explore whether the overall closeness of the parent-child relationship moderates this association. We hypothesize that higher levels of parent-child closeness will buffer the potential negative effects of excessive media use on interaction quality, making relationships with stronger emotional connections more resilient to daily strains. Last, we examine gender differences across these effects and hypothesize that girls will be more vulnerable to the negative associations between social media use and parent-adolescent interaction quality. By focusing on within-person dynamics and considering the moderating role of relationship closeness, this study aims to provide a more nuanced

understanding of how electronic media use is related to parent-adolescent relationships on a day-to-day basis.

2 Method

2.1 Participants

The current study used data from the Future Families and Child Wellbeing Study (FFCWS), a longitudinal birth cohort study targeting children born to unmarried parents. Beginning with its first wave of data collection in 1998-2000, the FFCWS followed 4,898 children and their families throughout youth development and into young adulthood. Here, data from a subsample (Age = 15; N = 1,545) of youth were randomly selected to participate in a sleep study that included keeping a daily diary. For the daily diary data, youth answered web-based survey questions regarding sleep, screen use, family interaction quality, and affect for seven consecutive days. Family interaction and screen use data surveys were administered online at approximately 19:00 (7:00PM).

2.2 Measures

2.2.1 Electronic media use

Youth were asked daily "*about how many hours did you spend (more than one activity at once is okay)*" for the following electronic categories: "(1) Communicating with friends by email, instant messaging, texting on your phone, or through social media sites, such as Facebook, or Twitter," "(2) Playing games on the computer, TV, or a handheld device," and "(3) Watching TV, videos, and movies (on any device)". Available responses included 0, 1, 2, 3, 4, or 5 or more. Social digital media was simply the response to question (1) while entertainment digital media use was a composite of questions (2) and (3).

2.2.2 Parent-adolescent interaction quality

To measure parent-child interaction quality, youth responded yes (1) or no (0) each day to the following question: "*Did you get along with your parents today?"*.

2.2.3 Parent-adolescent closeness

Youth reported on their perception of closeness with their parents by responding to two items from the Family Functioning, Middle Childhood and Adolescent sections of the National Survey of Children's Health survey. Items referred to how well youth and their primary caregivers talk and exchange information. Likert type response sets ranged from 1 (Extremely well) to 4 (Not very well).

2.2.4 Covariates

Gender and income will be included as covariates.

2.3 Analytic Plan

First, we examined descriptive statistics and bivariate correlations among study variables. Then, multilevel modeling (MLM) was used to test study hypotheses. To justify using MLM, we first calculated the intraclass correlation coefficient (ICC) to quantify the proportion of within-person variance to the total variance. A smaller ICC suggests more of the total variance in the outcome is due to within-individual differences across observations (i.e., Level 1 variance), rather than between-individual differences (i.e., Level 2 variance). We then employed Satorra-Bentler scaled chi-square difference tests to determine whether random effects should be retained in each model (Satorra & Bentler, 2001). Specifically, compared nested models, with and without random slopes u_{1i} or intercepts u_{0i}, to assess whether the inclusion of these random effects significantly improved model fit. The chi-square difference test evaluates whether the increased complexity of a model is justified by a better fit to the data.

Model 1 examined daily associations between electronic media use and family interaction quality according to the following structure:

Level 1 (Within-individual):
$FIQ_{ij} = \beta_{0i} + \beta_{1i} \times (EMU_{ij}) + \epsilon_i$

Level 2 (Between-individual):
$\beta_{0i} = \gamma_{00} + u_{0i}$
$\beta_{1i} = \gamma_{10} + u_{1i}$

In this model, observations *j* (i.e., days) were nested within individuals *i*. Level 1 captured how daily fluctuations in electronic media use (EMU) were associated with daily variations in family interaction quality (FIQ) within the same individual. Then, level 2 explains how averages differed between individuals across observations.

We then explored lagged effects in Models 2 to determine whether evidence supports directional effects across days.

Level 1 (Within-individual):
$FIQ_{ij} = \beta_{0i} + \beta_{1i} \times (EMU_{ij-1}) + \epsilon_i$
$EMU_{ij} = \beta_{0i} + \beta_{1i} \times (FIQ_{ij-1}) + \epsilon_i$

Level 2 (Between-individual):
$\beta_{0i} = \gamma_{00} + u_{0i}$
$\beta_{1i} = \gamma_{10} + u_{1i}$

Specifically, we estimated the effect of digital media use on the next day parent-adolescent interaction quality and simultaneously the effect of parent-adolescent interaction quality on next day digital media use.

In Model 3, adolescent-caregiver closeness was added to Model 1 (i.e., the same day associations model) as a between-individual moderator according to the following formulas:

Level 1 (Within-individual):
$FIQ_{ij} = \beta_{0i} + \beta_{1i} \times (EMU_{ij}) + \epsilon_i$

Level 2 (Between-individual):

$\beta_{0i} = \gamma_{00} + u_{0i}$
$\beta_{1i} = \gamma_{10} + \gamma_{11}\ x\ C_i + u_{1i}$

Here, adolescent-caregiver closeness was included at Level 2 to determine whether the effect of within-individual EMU on FIQ depends on parent-child closeness (C). The coefficient γ_{11} indicated the strength of this moderating effect.

Lastly, all models were tested for gender differences using Chi-square difference tests. If empirical support for gender differences were found, those multi-group models were tested and those results reported.

3 Results

3.1 Descriptive statistics

Table 1 shows between-level means, standard deviations, and bivariate correlations for study variables. Overall, girls reported using more social media use (r = .18, p < .01) and less video games (r = -.21, p < .01) while boys reported being closer to primary caregivers (r = .07, p < .01).

3.2 Same day model

A Satorra–Bentler scaled chi-square difference test showed the random effects model did not significantly improve the model fit over the fixed effects model ($\chi^2_{diff}(1) = 1.46$, $p = 0.23$). Moreover, there was no support for gender differences ($\chi^2_{diff}(6) = 6.03$, $p = 0.42$). Results showed an ICC of .254 suggesting most of the variance is due to within-level (i.e., daily) fluctuations in parent-child interaction quality. No significant covariate effects were found for within-level school day or between-level youth sex, income, or parental education. Moreover, neither social media use nor entertainment media use was related to within-level (social: b = .003, SE = .004, β = .013, p = .454; entertainment: b = .003, SE = .003, β = .020, p = .348) or between-level parent-

child interaction quality (social: b = .000, SE = .004, β = .004, p = .941; entertainment: b = -.006, SE = .004, β = -.085, p = .179).

3.3 Closeness as a moderator

We then added between-level parent-child closeness as a moderator to test whether the effect of social media use and entertainment media use on parent-child interaction quality varied accordingly. Neither interaction was significant, suggesting the within-level impact of electronic media use did not depend on parent-child closeness.

3.4 Lagged models

Social EMU and entertainment EMU were tested in separate models for the lagged tests. Satorra-Bentler scaled chi-square difference tests did not provide support for gender differences in either model (social: $\chi2(4) = 4.59$, $p = 0.33$; entertainment: $\chi2(4) = 3.47$, $p = 0.52$). We found that more social media use significantly predicted better next day parent-child interaction quality (b = .011, SE = .005, β = .044, p = .038). However, no other significant next-day associations were detected.

4 Discussion

Families currently navigate a historically novel technological context due to the proliferation and evolution of screen technology in recent years. Although prior research has shown that youth EMU levels are related to parent-child interaction quality in a broad sense (Carvalho et al., 2015), studies examining how within-level fluctuations in screen use is related to parent-child interaction quality are scarce. The current study addressed this gap by testing the daily associations between youth EMU (i.e., social and entertainment types) and parent-child interaction quality across one week in adolescent youth. We found that there were no significant same day associations between EMU and parent-child interaction quality. However, we did find

that previous day social media use significantly predicted better interaction quality the next day. This finding suggests claims that EMU negatively impacts parent-child systems in middle adolescence may be overstated or limited to aspects of functioning outside of interaction quality.

Our first hypothesis that higher levels of social EMU would be associated with worsening parent-child interaction quality was not supported by our results. This is in line with one previous EMA study that found no significant associations between youth EMU and parent-child interaction quality after correcting for multiple comparisons (Jensen et al., 2021). Youth typically begin using social media before 12 years old (Rideout et al., 2022). Thus, our sample of 15-year olds have likely been using social media for multiple years on average by the time this data was collected. According to dynamic systems perspective, novelty is expected to disrupt interactions between system components (Fogel, 2011). However, through these interactions systems self-organize into stable patterns of behavior (Granic et al., 2003). Therefore, by 15-years old, parent-child relationships may have already settled into stable relational dynamics that integrate social media. Future studies should examine these daily associations in early adolescence when youth typically using social media and carrying smartphones.

We also showed a lack of support for the hypothesis that the daily association between EMU and parent-child interaction quality was moderated by overall parent-child closeness. This null finding suggests that the impact of EMU did not depend on parent-child closeness. Our measures of closeness might not have captured the specific aspects of the parent-child dynamic that modify the disruptive effects of smartphone use. Future research should examine whether other relationship factors, such as parental monitoring, communication styles, or conflict resolution strategies, moderate the impact of EMU on interaction quality. Understanding these

nuances could inform interventions aimed at mitigating digital disruptions and enhancing parent-child engagement across all families.

Second, contrary to our hypothesis, social media use was associated with better next-day parent-child interaction quality. This result is contrary to prior evidence showing negative associations between social media and parent-child relationship quality (Sampasa-Kanyinga et al., 2020). This surprising finding suggests that, under certain conditions, social media may facilitate communication or serve as a supplemental channel for positive engagement between parents and adolescents. For example, social media might enable youth to share aspects of their daily experiences that otherwise would go uncommunicated, prompting more responsive or supportive parental reactions the following day. In support, it has been previously shown that online social networking with parents can improve feelings of being connected (Coyne et al., 2014). Alternatively, these results may reflect contextual factors in our sample, such as moderated or purposeful social media use that enhances rather than detracts from family dynamics. Future research should further investigate the conditions under which social media use might contribute to improved parent-child interactions, including potential mediators and moderators, to clarify these unexpected benefits.

Finally, our analyses revealed no gender differences in the daily associations between EMU and parent-child interaction quality among adolescent youth. This suggests that the lack of influence of electronic media use on daily interactions operates similarly for boys and girls.

Limitations

Results of the current study should be interpreted in light of several limitations. First, one source of weakness in the current study lies in the measurement of parent-child interaction quality. This youth-reported construct was measured via a single binary item where youth were

asked if they "[got] along with their parents today" offering limited insights into parent-child interactions. Future studies should include questions about joint activities, communication, and emotional connectivity, all of which could vary even on days when youth got along with their parents. Although this method has been used in prior studies, more comprehensive measurements may reveal more variability in parent-child interaction quality, thus increasing the power to detect effects. Moreover, we observed low levels of negative interaction quality in general, which also undermined our ability to detect effects. Second, the current study sampled 15-year olds. Future studies should examine youth earlier in adolescence to see if social media is more disruptive to the parent-child relationship youth begin accessing it. At this stage, social media may be more disruptive as it introduces novelty into the parent-child dynamic system.

Conclusion

The current study adds support for the perspective that digital media use is currently a normative aspect of adolescent ecology and does not impact whether parents and children get along at this age. In fact, evidence that higher levels of social media use preceded better next day interaction quality indicates potential benefits for the parent-child relationship. It may be that electronic media has a greater impact when it is first introduced to the parent-child system. Future studies should test daily associations between digital media use and parent-child interaction quality earlier in adolescence to determine whether this is the case. Moreover, future studies should test other aspects of the parent child relationship to determine whether the findings of the current study are limited to whether parents and children got along.

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Table 1

Between-level means, standard deviations, and correlations with confidence intervals

Variable	*M*	*SD*	1	2	3	4	5	6
1. Sex (M=1,F=2)	1.48	0.50						
2. Income	65114.22	68012.88	-.00					
3. Social mean	2.16	1.52	.18**	-.07				
4. Videogame mean	1.49	1.31	-.21**	-.06	.22**			
5. TV/Movies mean	1.79	1.18	-.03	-.08*	.28**	.44**		
6. PC Interaction mean	0.99	0.33	.02	-.06	-.00	-.00	-.10**	
7. Closeness mean	1.78	0.77	.07**	-.01	.05	.03	-.01	-.01

Note. M and *SD* are used to represent mean and standard deviation, respectively. * indicates $p < .05$. ** indicates $p < .01$.

Table 2

Parameter estimates for within-day associations between digital media use and parent-child interaction quality

	b (*SE*)	*β*	*p*
Level 1			
Social → PCIQ	.003 (.004)	.013	.454
Entertain → PCIQ	.003 (.003)	.020	.348
School Day → PCIQ	.010 (.009)	.021	.301
Level 2			
Closeness x Social → PCIQ	.000 (.004)		.925
Closeness x Entertain → PCIQ	.002 (.003)		.449
Social *M* → PCIQ	.000 (.005)	.004	.941
Entertain *M* → PCIQ	-.006 (.004)	-.085	.179
Youth Sex → PCIQ	-.005 (.013)	-.019	.704
Income → PCIQ	.000 (.002)	-.004	.954
Parent Edu → PCIQ	-.001 (.007)	-.008	.876

Note. PCIQ = Parent-child interaction quality, Edu = education, M = mean.

Table 3

Parameter estimates for bidirectional next-day associations between digital media use and parent-child interaction quality

	b (SE)	β	p
Level 1			
Social $_{t-1}$ → Social $_{t}$	-.029 (.026)	-.025	.274
PCIQ $_{t-1}$ → PCIQ $_{t}$	-.110 (.032)	-.098	.001
Social $_{t-1}$ → PCIQ $_{t}$	.011 (.005)	.044	.038
PCIQ $_{t-1}$ → Social $_{t}$	.097 (.106)	.018	.362
Entertain $_{t-1}$ → Entertain $_{t}$	-.006 (.024)	-.005	.800
Entertain $_{t-1}$ → PCIQ $_{t}$	-.002 (.003)	-.013	.538
PCIQ $_{t-1}$→ Entertain $_{t}$			
WP covariance: PCIQ and Social	.007 (.005)	.031	.134
WP covariance: PCIQ and Entertain	.004 (.009)	.011	.682
Level 2			
Intercept (mean): PCIQ	.941 (.029)	6.939	<.001
Intercept (mean): Social	1.708 (.261)	1.191	<.001
Intercept (mean): Entertain	4.871 (.362)	2.695	<.001
BP covariance: PCIQ and Social	.002 (.011)	.012	.838
BP covariance: PCIQ and Entertain	-.018 (.018)	-.074	.324

Note. Lagged terms for parent-child interaction quality, social, and entertain (t – 1) were person-mean centered for the model tests. PCIQ = Parent-child interaction quality, WP = Within-person, BP = between-person.

CHAPTER 4

DISCUSSION AND CONCLUSION

Conclusion

The current evolving technological ecology presents unique challenges for parent-child relationships from prior generations. With the rapid adoption of EMU by youth in recent years, a growing body of research has emerged on its impact on families. Yet, significant gaps remain. For example, no studies to date have examined whether youth smartphone ownership impacts parents' awareness of changes in their children's mental health. Moreover, associations between EMU and parent-child interaction quality at shorter timescales are scarce. To address these gaps, this work investigated potential susceptibilities introduced by youth digital media use on the parent-adolescent system during this formative developmental period. In particular, two studies were conducted to test 1) the role of early smartphone ownership in parent-child informant discrepancy of youth internalizing problems in early adolescence and 2) the daily associations between youth EMU and parent-child interaction quality in middle adolescence. Results from these studies broaden current understanding regarding impacts of youth EMU on the parent-adolescent system.

Overall, these two studies were disparate in their support for hypotheses. In Study 1, hypotheses were mostly supported by results. However, Study 2 results showed mostly null effects and one finding that was contrary to hypotheses. First, this inequivalence may be due to the differences in age between the two samples. The sample for Study 1 targeted a transitionary period in youth technology habits as youth tend to begin social media use and acquire

smartphones during these years. Transitionary perturbations are in line with dynamic systems theory in that novel inputs are expected to disrupt patterns of interactions for a period of time (Granic et al., 2007; Hollenstein et al., 2013). In contrast, Study 2 drew from a sample of 15-year olds who, on average, would have used social media and smartphones for 3-4 years by this age (Rideout et al., 2022). Again, this can be interpreted within dynamic systems perspectives as self-reorganization occurs over time as systems re-establish stable patterns of interactions (Dishion et al., 2012). Second, these two studies targeted different aspects of the parent-child relationship. In Study 1, informant discrepancy effects are presumably underlain by parent-child communication, closeness, or other factors that contribute to child disclosure, parent solicitation, and other avenues for parents' awareness of mental health changes in youth. In contrast, the outcome in Study 2 was whether or not parents and children got along. It's possible that parents and children can "get along" despite diminished levels of closeness and communication. In fact, parents and children interact less frequently due to EMU without consequences for getting along.

Manuscript 1

Findings from Study 1 suggest that early smartphone ownership impacts youth mental health trajectories and parent-child informant discrepancy of youth mental health. First, youth reported higher levels of internalizing problems with earlier smartphone ownership. Moreover, youth-reported internalizing problems increased over time, except for those youth who did not own a smartphone. Second, in contrast to youth-report, parent-reported internalizing problems of their children did not increase across time, indicating a potential mismatch between reporters. Third, overall parent-child informant discrepancy of youth internalizing problems was more pronounced with earlier youth smartphone ownership. Last, the effect of the interaction between time and informant showed informant discrepancy increased over time when youth owned a

smartphone. Moreover, significant informant discrepancy emerged specifically in years after youth smartphone ownership began and never emerged in youth who did not own a smartphone. These findings suggest smartphones play a role in mental health trajectories across early adolescence. Moreover, Study 1 showed that youth smartphone ownership may undermine parents' ability to assess their children's mental health problems. This is important as early adolescence marks the time when internalizing psychopathology first emerges for many developing youth and early detection by parents is critical for mitigating long-term negative outcomes.

Manuscript 2

Study 2 tested the daily associations between youth EMU (i.e., social and entertainment types) and parent-child interaction quality across one week in adolescent youth. Results showed that there were no significant same day associations between EMU and parent-child interaction quality. Moreover, there was no evidence that these daily associations varied by dyads level of closeness. However, we did find that previous day social media use significantly predicted better interaction quality the next day. Overall, results from Study 2 revealed mostly null effects. By 15 years old, social media and other types of EMU have been integrated into the family system for multiple years, on average. It may be that the parent-child system has already reorganized around the various EMU types by this age. These findings support claims that EMU is a normative aspect of early adolescence and suggest there may be next day benefits of social media use for parent-child interaction quality.

Implications and Future Directions

Study 1 tested a novel hypothesis with a large, representative sample using advanced methodology. Findings from this study have several implications. First, while the literature is

mixed regarding the impacts of EMU and smartphones on youth internalizing problems, we showed that study conclusions can vary widely depending on informant. Future studies should design protocols with this in mind. Second, by examining internalizing trajectories over a longer than typical period of time (i.e., 3 years), Study 1 results suggest that cross-sectional studies and short-term longitudinal studies may neglect important broader timescale processes. While short-term studies are informative, parents and professionals are often concerned with long-term effects. Third, parents were more likely to underestimate their youths' internalizing problems when they owned smartphones earlier. These findings have important implications for parent-child relationships and suggest that some aspect of the parent-child relationship is impacted by youth smartphone ownership. Future studies should investigate mechanisms that underlie the informant discrepancy found in the current study. Last, the informant discrepancy continued to increase even after youth owned smartphones for multiple years. This suggests that the impacts on the relational factors that undermined informant agreement by youth smartphones were durable and continued for the duration of the study.

Study 2 tested daily associations between 15-year old youth EMU and parent-child interaction quality. First, the mostly null effects found in this study underscores the reality that EMU is a normative ecological aspect of adolescent development, especially by middle adolescence. Future studies should examine these daily associations at the onset of technological transitions such as when youth first begin using social media or when youth first own a smartphone. Moreover, other parent-child outcomes such as frequency of joint activities, emotional closeness, or communication should be investigated in future studies to determine whether these null findings are limited to parent-child interaction quality (i.e., whether or not parents and children got along). Second, lagged effects models showed that social media use was

related to better next day parent-child interaction quality. It may be that higher levels of social media use positively impacts mood, which in turn leads to less friction in the relationship. Nonetheless, this finding lacks support by previous research and should be confirmed in future studies. Third, same day and lagged effects models provided no support for the hypothesis that youth cope with parent-child conflict with increased EMU.

Summary

In summary, the impacts of youth technology use on the parent-child system were specific to parent-child informant discrepancy in early adolescence. In line with dynamic systems theory, this suggests that transition periods in youth technology use may be especially vulnerable periods for the parent-child relationship. In turn, targeted interventions during these transitions may be useful to mitigate the initiation of undesirable mental health and parent-child relationship quality trajectories. These findings broaden understanding of the role of media technologies in the parent-child system.

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