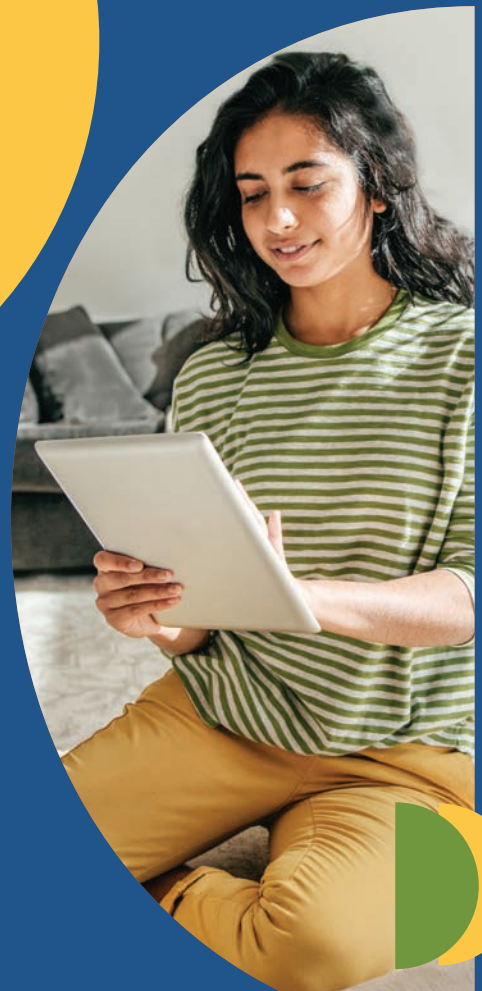
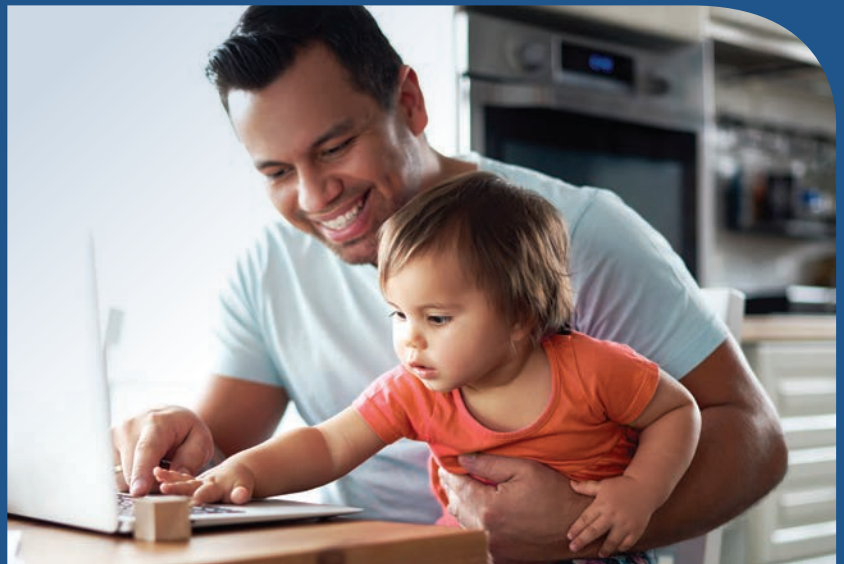




National Institutes of Health
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Addressing the Impacts of Technology and Digital Media on Infants, Children, and Adolescents: An NIH Research Agenda



Addressing the Impacts of Technology and Digital Media on Infants, Children, and Adolescents

A National Institutes of Health (NIH)
Research Agenda



Eunice Kennedy Shriver National Institute
of Child Health and Human Development

Contents

- Purpose..... 1**
- Introduction 1**
- Priority Areas..... 2**
 - Priority #1: Addressing Complexity: Modeling the complex relationships between TDM and child development and mental health 3**
 - Background..... 3
 - Examples 3
 - Priority #2: Enhancing rigor: Increasing the scientific rigor of TDM research 5**
 - Background..... 5
 - Examples 5
 - Priority #3: Expanding inclusion: Addressing the inclusion of groups underrepresented in TDM research 7**
 - Background..... 7
 - Examples 8
 - Priority #4: Informing Interventions: Expanding the evidence base for TDM-related prevention and intervention programs 8**
 - Background..... 9
 - Examples 9
 - Prevention* 9
 - Intervention* 10
- Conclusion..... 11**

Addressing the Impacts of Technology and Digital Media

Purpose

As specified in the Consolidated Appropriations Act, 2023 ([P.L. 117-328](#))(Act), Division FF, Title I, Section 1432(d), the Director of the National Institutes of Health (NIH), in consultation with national research institutes, academies, centers, relevant consortia, and non-federal experts, is to develop a research agenda on the public health and developmental effects of technology and digital media (TDM) on infants, children, and adolescents. Areas of study include (but are not limited to) cognitive, physical, and socio-emotional health (including mental health) effects with a goal of identifying relevant research opportunities and gaps. This Research Agenda outlines specific priority areas to advance our understanding of the impacts of TDM use during development.

In this document and as specified in the Act, TDM encompasses social media, applications, websites, television, motion pictures, artificial intelligence, mobile devices, computers, video games, virtual and augmented reality, and other content, networks, or platforms disseminated through the internet, broadcasted, or other media technologies, as applicable. As per the NIH definition¹, hereinafter “children” refers to individuals from birth through 17 years of age.

Introduction

Children spend an increasing amount of time actively engaging with TDM, which raises questions regarding the safety and long-term ramifications of these activities. Parents, teachers, policymakers, and even children themselves look to researchers and clinicians for guidance on how to maximize the potential benefits and minimize potential harms associated with using TDM. Despite a substantial increase in TDM research focused on children, much remains unknown regarding the potential positive, negative, and neutral impacts of TDM use and exposure across development.

The [Eunice Kennedy Shriver National Institute of Child Health and Human Development \(NICHD\)](#) and the [National Institute of Mental Health \(NIMH\)](#) developed this Research Agenda after engaging in multiple efforts to examine the current state of research on children’s TDM use and exposure. These efforts included collaborative meetings with other NIH institutes and centers, other federal agencies, and Congressional staff.

¹ [NOT-OD-16-010: Inclusion of Children in Clinical Research: Change in NIH Definition](#)

This agenda aligns with and complements other federal efforts in this topic area, including the White House [Kids Online Health and Safety Taskforce Report](#); the 2024 National Academies of Sciences, Engineering, and Medicine [Social Media and Adolescent Health Consensus Study Report](#); and the Surgeon General's 2024 [Advisory on Social Media and Youth Mental Health](#). In addition, this Research Agenda is informed, in part, by insights gained through the April 2024 public meeting, *Impact of Technology and Digital Media on Child and Adolescent Development and Mental Health*, co-hosted by NICHD and NIMH. The workshop brought together researchers from diverse scientific and clinical disciplines, staff from federal departments and agencies, and representatives from scientific societies, advocacy groups, and the public. An executive summary, recordings, and additional information are available on the [meeting webpage](#).

Priority Areas

This Research Agenda identifies four priority areas that will advance our understanding of how TDM impacts child development. An overarching theme of this Agenda is to emphasize the need for balanced research on the potential harms and benefits of TDM use and exposure across development. Much of the current research emphasizes the harms of TDM for children (e.g., the promotion of risky behaviors, negative impacts on physical health such as sleep and body image, disrupted parent-child interactions, increased stress). However, TDM use and exposure can also have beneficial impacts (e.g., access to educational resources, interventions that support neurocognitive development and learning abilities, building a sense of community), as well as neutral or no effects. Given the ubiquity of TDM in the lives of children, a more balanced approach to TDM research, including publishing results when no effects are found, can help inform policies and practices to increase the benefits of TDM, while minimizing harms. Each priority area includes balanced approaches to understanding the impacts of TDM across development.

The four priority areas highlighted by this Research Agenda are:

1. Addressing Complexity
2. Enhancing Rigor
3. Expanding Inclusion
4. Informing Interventions

Each priority area section includes background information and research examples, reflective of current knowledge gaps and methodological limitations, that address topic areas of particular importance to children and the communities that serve them. Examples provided are not meant to be exhaustive or all-inclusive and may be updated and refined as research progresses.

Priority #1: Addressing Complexity: Modeling the complex relationships between TDM and child development and mental health

Research should aim to address and explain the complex biological, psychological, and social factors that interact to mediate the impacts of TDM use and exposure on health across development. Factors to consider may include developmental stage, features of the individual child (e.g., temperament, identified physical, intellectual, developmental, and learning disabilities, mental illnesses and disorders), family member factors (e.g., family TDM usage, supervision, and involvement), peer characteristics (e.g., supportive social networks, cyberbullying), environmental influences (e.g., socioeconomic status, community factors), as well as the context (e.g., viewing with a parent or caregiver) and content (e.g., educational) of the TDM.

Background

While emerging research has explored the potential impacts of TDM use and exposure across and within specific groups, it is critical to further understand the individual and contextual factors that shape these complex relationships. Individual characteristics (e.g., sex/gender, race and ethnicity, social skills, mental illness) and experiences (e.g., TDM use by family members and peers, participation in sports and/or social group activities) can shape one's engagement with TDM and its impacts. These associations may also shift over time and may be direct or indirect through factors such as sociodemographic factors, family dynamics, and/or peer relationships. Such factors can amplify positive or negative impacts of TDM for different users, increasing or decreasing susceptibility to benefits or harms in unique ways.

Childhood, from infancy through adolescence, is a time of significant neural plasticity and development in physical, cognitive, and socioemotional domains, which creates opportunities for both vulnerability and resilience. Many mental illnesses display first symptom onset during childhood and adolescence, highlighting the importance of increased understanding of the interactions between psychopathology symptoms and TDM use. Important questions remain regarding how TDM use not only affects, but *interacts* with, development, including comparisons within and across different ages, as well as sensitive periods during which the developing brain may be most impacted by TDM use and exposure. Children at risk for or with identified physical, intellectual, developmental, learning, and other disabilities, as well as mental illnesses, may exhibit different interactions between TDM use and exposure and development. Moreover, longitudinal studies can examine dynamic and relational factors regarding who may be more vulnerable or more resilient depending on developmental sensitive periods.

Examples

Research in this priority area may include:

- Identifying neurobiological, psychological, and environmental factors that shape how children interact with and experience potential negative, positive, or neutral effects of TDM

- Assessing the relationships between TDM use and exposure and sensitive periods of brain development in children, including the neural mechanisms of risk and protective factors that mediate and/or moderate these relationships
- Holistically capturing the dynamic relations between family processes, TDM use and exposure patterns, and children’s social, cognitive, and physical development and mental health
- Exploring the bidirectional interactions and potential differences between in-person and digital social engagement patterns (e.g., sports/online gaming, social activities/social media), and how these patterns shape developmental trajectories and cognitive, physical, socioemotional, and mental health outcomes
- Identifying the mechanisms by which TDM use and exposure interact with social and environmental risk and resilience factors to impact developmental trajectories (e.g., neurocognitive, behavioral, linguistic, socioemotional, and physical) and associated positive, negative, neutral, or no effects on health and mental health outcomes
- Understanding potential long-term impacts of caregiver TDM engagement patterns during infancy and early childhood
- Examining the influences of parent and peer behaviors on TDM use, risk, and resilience for deviations from typical development, and risk or resilience for psychopathology
- Examining the influence of existing subclinical or diagnosed psychopathology on TDM use, and identifying the risk or resilience factors associated with changes in use and mental health outcomes
- Understanding and evaluating the impact of cross-generational interactions with and through TDM platforms
- Understanding how TDM use and exposure both impacts and can be leveraged to help children with physical, intellectual, developmental, learning, and other disabilities
- Understanding the mechanisms by which children engage with artificial intelligence (AI) agents in the TDM space, the potential harms and benefits of engagement with AI (e.g., use of AI to generate homework answers and reports, increased engagement via use of AI tools for learning, problem solving, and pro-social development), and the affordances that could be built into AI tools to facilitate children’s effective engagement and leveraging of these tools
- Leveraging learning opportunities afforded by various TDM platforms, including second language acquisition, interactive educational activities promoting school

readiness skills, and supports for children with learning disabilities and other special needs

Priority #2: Enhancing rigor: Increasing the scientific rigor of TDM research

Further research should work toward developing and standardizing tools, measures, and study designs that will enhance the rigor and reproducibility of TDM research, including sophisticated, objective, and fine-grained approaches to assess TDM use that move beyond simple assessments of time spent on TDM. Increased harmonization and rigor of TDM measures will facilitate comparisons across studies to ensure reproducibility of results and allow for meta-analyses. Importantly, greater consistency across TDM studies will allow for broader generalizations about the impacts of TDM use and exposure during development. Finally, study designs that can address questions of causality—rather than correlation—between TDM and its potential impacts are important for addressing questions about the short- and long-term impacts of TDM use and exposure on child development and mental health outcomes.

Background

Historically, the primary objective measure utilized in this type of research has been time spent on TDM, typically described as “screen time.” Studies using screen time as a predictor of various cognitive and behavioral outcomes have yielded inconsistent results. This inconsistency is likely because screen time measures reflect very broad use patterns and lack nuance to account for the content of the TDM used, as well as the context in which TDM use occurred.

Given the well-documented challenges of collecting TDM data and the ever-evolving TDM landscape, researchers have developed novel instruments, assessments, data collection methods and measures to more accurately capture specific TDM experiences. However, the diffuse development and utilization of these assessments make it difficult to compare results across studies and to make broad generalizations about the impacts of TDM use and exposure during development. Further, rapid technology development makes measures focused on specific TDM platforms and platform-based metrics (i.e., likes, retweets) quickly irrelevant.

To determine the direction of specific effects (i.e., causality as opposed to correlation), experimental study designs, including randomized controlled trials (RCTs), are needed. Such studies will advance understanding of how specific features of TDM impact development. Rigorous longitudinal observational studies are also needed to examine the holistic and complex considerations emphasized in Priority #1.

Examples

Research in this priority area may include:

- Developing measures and approaches that more accurately capture TDM use and exposure to better characterize TDM use during development, such as:
- Passive digital trace data, such as text analysis or movement and Global Positioning System (GPS) data, to study TDM use in the user's context and the content of TDM used
 - Real-time measures of TDM use and exposure in a variety of settings (e.g., home, school, community) across multiple devices (e.g., smart phones and watches, tablets, gaming consoles), including family members' use of and parental efforts to regulate TDM use and exposure
 - Measures that capture experiences and affordances shared across TDM platforms rather than platform-specific variables
 - Standardization of measures used across studies to enhance generalizability of results and the ability to draw inferences across individual studies
 - Validating screening measures of TDM use and exposure that are predictive of later problematic use (e.g., engagement in gaming to the exclusion of school/work attendance) to inform prevention and intervention programs
- Designing studies to examine the temporal and causal associations between TDM, child development, and mental health outcomes and the mechanisms underlying these associations, such as:
- Accelerated longitudinal designs to capture differential impact across developmental stages in a faster timeframe than traditional longitudinal studies
 - Natural experiments to examine how society, community, and family-level changes in TDM use and access impact developmental and mental health outcomes
 - Experimental paradigms, including RCTs, that test potential causal mechanisms through which TDM use impacts physical, cognitive, and socioemotional health
 - Observational studies to better understand unmanipulated, real-world contexts and behaviors
 - Neuroimaging studies to explore how TDM experiences are processed in the developing brain, documenting individual differences and variability associated with amount, type, and format of TDM use and exposure

- Involving children and their families in research design when possible, such as through Youth Advisory Boards, to advise on variables of interest and experimental design, including feasibility

Priority #3: Expanding inclusion: Addressing the inclusion of groups underrepresented in TDM research

Research in this area should aim to understand how children from communities traditionally underrepresented in TDM research interact with and experience TDM and increase the generalizability of findings. Expanding engagement of individuals (e.g., children with physical, intellectual, developmental, learning, and other disabilities and mental illnesses) and groups (e.g., racial, ethnic, and sexual and gender minority communities, and residents of rural and semi-rural communities) currently underrepresented in TDM research has the potential to uncover community-specific impacts of TDM use, including risk and resilience factors. Additionally, given the potential benefits of TDM, research should investigate how best to leverage these outcomes for all people and to expand access to TDM for all children.

Background

To date, most participants in TDM research based in the United States are from majority racial and ethnic groups and from families in urban and suburban coastal regions. These trends limit the generalizability of TDM findings by hindering the identification of unique experiences for underrepresented communities that may confer risk and/or resilience for harms and benefits of TDM use and exposure. Understanding community-specific risk and resilience factors will inform efforts to prevent and mitigate the negative impacts of TDM for all children across development.

In addition, TDM, and social media in particular, expands the sphere of available social interactions in ways that prior generations did not experience. The digital environment may provide positive information, resources, and a virtual community that support care and self-help, particularly for children physically separated from a broader community of support. For example, children who live in rural communities may encounter a lack of shared experiences in their offline environments. Therefore, they might seek out support (e.g., exploring identity or gaining acceptance) on issues, such as race and ethnicity, that is more readily available to them online. On the other hand, the digital environment and social media use may mirror or exacerbate negative influences on mental health, exposing users to discrimination, judgement, and isolation based on any number of factors. Negative exposures can range from viewing racist and discriminatory images and language and bullying, to harassment and the potential for virtual blackmail, “sextortion,” and real-life violence. Further, negative exposures can also perpetuate stereotypes or create unrealistic or biased expectations, such as those related to physical ideals that are unrepresentative of the full breadth of human body types and attributes.

Designing studies that reflect the needs and interests of the community being studied is also central to this priority area. Engaging children, families, and their broader communities in every stage of the research—from creating research questions and data collection approaches, through the interpretation of findings—can provide the critical insights needed to more appropriately capture meaningful variables of interest on the ways children and families are using TDM. Use of Youth Advisory Boards (consistent with participant age) and other proven methods of engagement, especially those that include children and families with diverse perspectives, are also vital to these processes. Further, when possible, researchers should partner with communities to develop research projects, including but not limited to community-based participatory research approaches.

Examples

Research in this priority area may include:

- Exploring the unique impacts and needs of families and children with reduced TDM access (e.g., those in rural areas or with low socioeconomic status) across development
- Examining the impacts of exposure to, or targeting of, hate-based content online, such as hate speech and related symbols and other imagery, during childhood and its associated outcomes
- Understanding how TDM use and exposure impacts children with physical, intellectual, developmental, learning, and other disabilities, as well as those at risk for or experiencing mental illness
- Leveraging TDM to understand and address community-specific disparities in access, use, and/or engagement with health-related information and services
- Understanding culturally specific resilience and protective factors that minimize the likelihood of adverse outcomes following TDM use and exposure
- Including community partners and input in research to ensure that activities reflect the interest and values of the populations participating in the research

Priority #4: Informing Interventions: Expanding the evidence base for TDM-related prevention and intervention programs

Additional research is needed to determine the types of tools that can most effectively teach children how to safely, meaningfully, and intelligently participate in the digital world. Moreover, research should develop and evaluate programs that can build resilience, prevent negative consequences, and intervene to support individuals already experiencing the harmful impacts of TDM use and exposure. This research should also identify children who are at increased risk for negative physical, cognitive, and

socioemotional outcomes and provide resources and/or early intervention to mitigate risk and safeguard mental health. Further, this work could leverage TDM as the platform by which to accomplish these goals, when appropriate.

Background

As the digital world continues to expand, it is increasingly important to understand how best to empower children and their communities (e.g., parents, teachers, community leaders) to engage with TDM intentionally and responsibly. Despite the great need for programs and educational curricula that address digital literacy² and digital citizenship³ across developmental stages, few evidence-based programs are available.

There is increasing recognition that certain groups (e.g., adolescent girls, certain vulnerable populations) are at higher risk for problematic TDM use and/or for experiencing harmful effects of TDM, yet more research is needed to identify key individualized behaviors and characteristics that might indicate risk and the need for prevention or intervention actions. Better understanding of the individual factors that signal risk can also support development of more customized, effective prevention and intervention programs.

Research focused on TDM as a platform for facilitating the identification of children experiencing or at risk for problematic use and other negative outcomes (e.g., victimization, developmental delays, mental illness) and for delivering evidence-based preventive and therapeutic interventions is also needed. This work can inform how researchers, clinicians, and caregivers use TDM to gauge which children may be at risk for physical, cognitive, and/or socioemotional issues, both related and unrelated to TDM use and exposure.

Examples

Research in this priority area may include:

Prevention

- Determining the types of information/instruction regarding digital citizenship and literacy that are important and accessible at each developmental stage, including information for caregivers as they support and monitor their own and their children's TDM engagement
- Building developmentally appropriate curricula that maximize benefits (e.g., friendships and relationships, health behaviors, identity exploration, and self-

² The U.S. Agency for International Development defines [digital literacy](#) as “the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital devices and networked technologies for participation in economic, social, and political life.”

³ [Digital citizenship](#) refers to appropriate, responsible behavior when using technology.

esteem) and minimize harms (e.g., cyberbullying and peer victimization) of TDM use

- Developing, optimizing, and testing preventive interventions to increase resilience in children exposed to negative online messages and experiences (e.g., hate focused, cyberbullying, rejection/exclusion, discrimination, harassment), and to facilitate coping and other adaptive behaviors, especially among those with or at risk for mental illnesses
- Testing technology-based approaches to managing problematic TDM use or exposure in children
- Evaluating the effectiveness of family media plans on children's use and exposure to TDM and subsequent cognitive, physical, and social developmental outcomes, including rigorous testing of TDM management strategies (e.g., setting time or content limits, parental monitoring) and their implementation in family settings
- Testing novel strategies for managing TDM use and screen time (e.g., family-based interventions) that can augment preventive and therapeutic interventions for children with or at risk for mental illnesses
- Leveraging TDM to promote positive health behaviors, such as reducing risky behaviors and promoting positive identity exploration and body image, improved health literacy, and healthy relationships
- Understanding the preventative role that parents and caregivers can play in modeling and scaffolding TDM use for their children in ways that maximize the likelihood of positive effects and minimize harmful effects

Intervention

- Leveraging partnerships with purveyors of mental health-related information to provide accurate content (i.e., psychoeducation), embedding online screening tools for early detection, and incorporating strategies that promote referral, help-seeking, and treatment engagement
- Building personalized interventions based on individual needs and/or identifying those at risk, such as by using TDM data to develop and validate algorithms for identifying exposure to negative online experiences or content, and gauging potential benefit from mental health evaluation or interventions
- Building dynamic, personalized intervention tools that leverage children's socioemotional and cognitive strengths, especially for those struggling to build foundational skills in academic and learning domains and digital literacy skills

- Optimizing and testing therapeutic interventions for children who are victimized online to facilitate coping and other adaptive behavior, especially among those with or at risk for mental illnesses
- Examining how TDM platforms might facilitate delivery of scalable, research-informed, preventive and therapeutic interventions that might offer first-line support to help mitigate provider shortages and limitations in available mental health services

Conclusion

The priority areas outlined in this Research Agenda provide a conceptual approach to help guide NIH activities, including research funding, on the relationships among TDM use and exposure and the cognitive development and physical and mental health of children. This agenda emphasizes the need for a balanced approach to understanding both potential benefits and harms associated with TDM use and underscores the importance of understanding how use and exposure affect the development and mental health of the nation's children. NIH will continue to conduct and support research in this space to ensure families have access to research findings that help them make informed decisions about children's TDM use and exposure.