Mapping of Generative AI Impacts on Child Development

Emerging scientific consensus on anticipated benefits and risks



G7 - Call for international scientific contributions on the vulnerabilities created by the use of generative AI among minors

iRAISE

International Research-driven Alliance for AI Serving Every child

Table of Contents

Presentation 3

Credits 4

Executive Summary 7

1. Context 8

2. Age and Stage Matters: Developmental Sensitivity of GenAI Impacts 9

3. Youth adoption of GenAI: current evidence and the measurement imperative 10

4. GenAI opportunities and risks at different stages of development 11

- 0 to 3 years old 12

- 3 to 6 years old 14

- 6 to 12 years old 18

. Education & Learning 19

. Entertainment & Creativity 22

. Social and Relational Systems 25

- 12 to 18 years old 28

. Education & Learning 29

. Entertainment & Creativity 32

. Social and Relational Systems 34

5. Action Agenda: Priority Areas for AI Policy and Governance 37

References 39

Supporting Literature 41

Glossary 42

Working All Together For Beneficial AI For Children



everyone.AI

Everyone.AI is a non-profit, **whose mission is to anticipate, educate and evaluate the risks and opportunities that Artificial Intelligence (AI) presents, for children, adolescents and young adults** (0-25 years old) whose brains are still developing. As AI redefines our everyday experiences, it is imperative to ensure that AI's development and application are guided by principles.

Our priority is to promote rigorous research to identify the potential impacts of AI on young people and guide future activities. This research is the foundation for our **"awareness and education" activities targeting three specific audiences: Regulators and Decision-Makers, Product designers and Educators.**

everyone.AI

Paris Peace Forum

PARIS PEACE FORUM

The Paris Peace Forum, launched in 2018 to commemorate the end of World War I, **tackles global challenges like climate change, inequality, and security by fostering innovative collective action**. Bridging gaps in global governance, it brings together states, international organizations, NGOs, academics, and private sector leaders from North and South to build sustainable peace. **Its policy initiatives focus on critical areas such as climate action, transition minerals, agriculture, nutrition, AI, and cybersecurity, addressing the most pressing global issues**. Each November, its annual gathering showcases solutions, while year-round, it supports ten standout governance projects with tailored guidance to amplify their impact.

Children and Screens: Institute of Digital Media and Child Development

Children and Screens: Institute of Digital Media and Child Development is an independent nonprofit organization advancing interdisciplinary, **evidence-based research and education on how digital media and technology shape children's development, health, and well-being.** Free from technology industry funding, the Institute convenes international experts and translates research into practical guidance for families, educators, clinicians, and policymakers.

Children and Screens
Institute of Digital Media and Child Development

Credits

This mapping was developed within iRAISE under the scientific direction of everyone.AI, in collaboration with Children and Screens: Institute of Digital Media and Child Development. It reflects a shared effort to bring developmental science, children's rights, and youth digital wellbeing into AI governance.

Primary Authors

- **Mathilde Neugnot-Cerioli, Ph.D.**, *Chief Scientist at everyone.AI and iRAISE*
- **Daniel Hipp, Ph.D.,** *Senior Research Coordinator at Children and Screens: Institute of Digital Media and Child Development*

Scientific Editors

- **Kate Blocker, Ph.D.**, *Director of Research and Programs at Children and Screens: Institute of Digital Media and Child Development*
- **Maxime Le Bourgeois, M.Sc.**, *Cognitive Neuroscience Researcher at everyone.AI*
- **Olga Laurenty**, *AI and Child Development Researcher at everyone.AI*
- **Nandini Asavari Bharadwaj, M.A.**, *AI in Education and Child Development Researcher at everyone.AI*
- **Adam Dubé, Ph.D.**, *Associate Professor of Learning Sciences and leadership member for McGill's Collaborative for AI & Society*
- **Tracy Dennis-Tiwary, Ph.D.**, *Professor of Psychology and Neuroscience at The City University of New York*
- **Judith Danovitch, Ph.D.**, *Professor of Psychological and Brain Sciences at University of Louisville*
- **Isabelle Hau,** *Executive Director, Stanford Accelerator for Learning*
- **Allison Langer, Ph.D.**, *Impact Fellow at Children and Screens: Institute of Digital Media and Child Development*
- **Nina Vasan, MD.**, *Director of Brainstorm: The Stanford Lab for Mental Health Innovation*

Reviewers

- **Nicole Hipp, Psy.D.,** *Clinical Psychologist, Collegiate Coaching Services*
- **Caroline Lancelot Miltgen, Ph.D.,** *Social & Behavioral Scientist*
- **Pilyoung Kim, Ph.D.**, *Director of the Brain, Artificial Intelligence, and Child (BAIC) Center*
- **Mitch Prinstein, Ph.D.**, *Professor of Psychology and Neuroscience and the Senior Science Advisor of the American Psychological Association*
- **Jenny Radesky, M.D.,** *Division Director of Developmental Behavioral Pediatrics at Michigan Medicine*
- **Tara Steele**, *Executive Director The Safe AI For Children Alliance*
- **Sonia Tiwari, Ph.D.**, *Director of Research at Oki Pie Lab*
- **Sunny Xun Liu, Ph.D.**, *Director of Research at the Stanford Social Media Lab*

Suggested citation

Neugnot-Cerioli, M., Hipp, D. (2026) Mapping of GenAI impacts on child development: Emerging scientific consensus on anticipated benefits and risks. iRAISE

Endorsement

- **Aanchal Kapur,** *Consultant at What Works Hub for Global Education and British Council*
- **Adil Bilal**, *Lecturer at RMIT University*
- **Alina Kiran**, *Assistant Professor at BUIC*
- **Ana Catarina de Alencar,** *Resident Philosopher at The AI Collective, AI Governance and Relational AI Researcher*
- **Angelika Sharygina,** *Founder of Mindshld and PhD Researcher at Trinity College Dublin*
- **Anohar John,** *Advisor to the Board of Directors at Aero Horizon and Visiting Faculty at NISM*
- **Anthony Bridgen, PhD.,** *Programme Coordinator at Generation AI - Oxford Global Challenges Programme, University of Oxford*
- **Ashika Theyyil**, **MCM**, *Senior Media and Issues Advisor at the Government of Ontario*
- **Berenice Houston,** *CEO at RavenTrak*
- **Camille Vézy, PhD.,** *Senior User Researcher and Philosophy for Kids Facilitator*
- **Carla Aerts,** *Education Futures and AI/EdTech Consultant at TrAIn Of Thought*
- **David E. Harris,** *Chancellor's Public Scholar at UC Berkeley*
- **Diana Rubio Navarro,** *Dr., Neuroscientist and Educator*
- **Eglė Celiesienė, PhD.,** *CEO and Research Fellow at the Lithuanian College of Democracy; Chairwoman of the NGO Confederation for Children*
- **Elena Sinel,** *Founder and CEO at Teens in AI*
- **Elodie Jouny-Rivier, PhD.,** *Professor of Marketing at ESSCA School of Management. Son CV ESSCA*
- **Emma Ransome,** *School Lead for Teaching and Learning Quality at Birmingham City University*
- **Evija Mirķe,** *Lead Researcher at Augam kopa - Riga Technical University*
- **Evren Yiğit,** *Founder of Mako Kids and Consultant at KidsAI*
- **Francisco Valente Goncalves, PhD.,** *Assistant Professor, Health Sciences Faculty at Universidade Europeia*
- **Giulia Valentini,** *President of Associazione Lumen and AI Literacy Specialist*
- **Gulsah Kacmaz**, *Assistant Professor at Bartın University*
- **Hamilton Morrin,** *Academic Neuropsychiatrist at King's College London*
- **Hannah Griswold,** *Co-Founder & Advisor at San Diego Unified School District (SDUSD) Student Wellness Education and Resources (SWEAR) Committee, Stanford (BA, MA)*
- **Hechmi Kilani** - *PhD candidate*
- **Hilda Awwad, PhD.,** *Director of Aid Coordination and Grants at the Ministry of Education, Palestine*
- **Irakli Beridze,** *Head of the Centre for AI and Robotics at United Nations Interregional Crime and Justice Research Institute (UNICRI)*
- **Iris Oved, PhD.,** *Founder and Executive Director at The Paradox Lab*
- **Irving Martínez Pacheco, PhD.,** *Founder & AI Principal Researcher at Time Solutions Learning (TSL)*
- **Jaimie Lee Freeman, PhD.,** *Senior Staff Scientist at Queen Mary University of London*
- **Jasmine Anak Jain, PhD.,** *Associate Professor & Programme Director, Research Programmes, School of Education at Taylor's University, Malaysia*
- **Jean-François Brisson,** *CEO at Sparkainlpx.xyz*
- **Jennifer Heifferon,** *Program Director, Child Well-Being at California Partners Project*
- **Jeremy Roschelle, PhD.,** *Executive Director of Learning Sciences Research at Digital Promise*
- **Jinhee Kim, PhD.,** *Assistant Professor at Old Dominion University*
- **Joel Trudeau,** *DawsonAI Project Lead and Physics Faculty at Dawson College*
- **Jungmin Lee, PhD.,** *Research Fellow at KRIVET, Korea Research Institute for Vocational Education and Training*
- **Karen Goetz,** *Research Operations Leader in Clinical Research, AI Validation & Translational Systems*
- **Kris Perry,** *Executive Director at Children and Screens: Institute of Digital Media and Child Development*
- **Liliana Arroyo Moliner**, *Director of the Chair for Socially Responsible Digital Innovation (SoReDI) and Assistant Professor, Department of Society, Politics and Sustainability at Esade Business School, Universitat Ramon Llull*
- **Luana Lo Piccolo,** *Senior Advisor on AI Governance and Legal Strategy*
- **Mahnaz Roshanaei,** *Adjunct Assistant Professor at UC Santa Cruz and Stanford University*
- **Maha Jouini**, *Founder of CHIFAA (AI for Healing) and AI Ethics Researcher*

- **Manashi Ganguly,** Associate Vice President, Governance & Commercial Delivery at Tech Mahindra
- **Marita Adhiambo,** Edtech Program Officer at Dignitas Project
- **Maxime Derian, PhD.,** Co-founder at Technoréalisme.org
- **Meredith Wade,** MSc in Psychology and Neuroscience of Mental Health, King's College London
- **Michael Preston,** Executive Director at the Joan Ganz Cooney Center at Sesame Workshop
- **Michele Veldsman, PhD.,** *Neuroscientist and Programme Manager at the Mental Health Research Incubator, University of Oxford, and Founder of playroom*
- **Mike Jones,** *Founder at Ethis.AI*
- **Mirela C. C. Ramacciotti, PhD.,** *Researcher at the University of São Paulo (USP)*
- **Muhammad Arif,** *Postdoctoral Associate at Yale University*
- **Mussolini Salem Mugumbate,** *Founder and Director of Children of the Digital Age Zimbabwe (CODAZIM)*
- **Nasima Shakeel, PhD.,** *Assistant Professor in Early Childhood at Aga Khan University*
- **Paola Jaramillo Sullivan,** *PhD Student at University of Florida*
- **Peggy Yin,** *PhD Student and Director of Cognitive Security Task Force at Stanford*
- **Peter Floriano Borges**, *Assistant Professor, D. D. Kosambi School of Social Sciences and Behavioural Studies at Goa University*
- **Randy Kulman, PhD.,** *Founder and Executive Director at Digitally Nutritious and Child Neuropsychologist*
- **Roshni Lulla, PhD.,** *Co-Founder & Chief Research Officer at the Institute for Humane Robotics; Brain & Creativity Institute, University of Southern California*
- **Ruth Flaherty,** *Senior Lecturer in Law at University of Suffolk*
- **Ruth Martinez-Lopez,** *Assistant Researcher at Universitat Politècnica de Catalunya*
- **Sara Grimes, PhD.,** *Wolfe Chair and Professor, Department of Communication Studies at McGill University (Kids Play Tech Lab)*
- **Scott Traylor, Ed.M.,** *Strategic Product Advisor, Independent*
- **Shivi Gupta**, *Engineering Manager at Cognizant*
- **Shuli Gilutz, PhD.,** *Senior Advisor, Children's UX Strategy, Research and Design*
- **Simar Singh, PhD.,** *Postdoctoral Fellow at the University of California, San Francisco (UCSF)*
- **Sonia Livingstone, PhD.,** *Professor, Department of Media and Communications at the London School of Economics and Political Science (LSE)*
- **Stéphie Herlin,** *Head of Product and Research at KORA*
- **Sulbha Shantwan**, *Director, Independent Contributor*
- **Tania Brandak,** *Assistant Professor at William James Center for Research, Ispa - Instituto Universitário*
- **Teddy Nalubega, PhD.,** *Head of AI Division at Ubuntu Center for AI Governance and Innovation - Knowledge Consulting Limited*
- **Thao Ha, PhD.,** *Associate Professor of Psychology and Founder of the Future of Love Initiative at Arizona State University*
- **Vanesa Pérez Torres, PhD.,** *Permanent Professor, Department of Psychology at Rey Juan Carlos University*
- **Vera Radeva, PhD.,** *Education Director at XRPL Commons and Professor at Sciences Po Paris*
- **Vithika Yadav,** *Co-founder of Love Matters India*
- **Vivian Chong,** *CEO & Co-Founder at apgard ai*
- **Wan Zuraini, PhD.,** *Head of Quality at the National Cancer Institute Malaysia and ISO 42001 AI Lead Auditor*
- **Ying Xu, PhD.,** *Assistant Professor of Education at Harvard University*

EXECUTIVE SUMMARY

This science-informed policy brief responds to the G7 call for international scientific contributions on vulnerabilities created by the use of Generative AI (GenAI) among minors (0–17 years). It maps GenAI use cases across youth age ranges and argues for a governance framework that reflects the developmental needs of children and adolescents. Integrating decades of research on child-technology interaction (including emerging evidence on child and teen interactions with AI) with foundational principles of human development, this brief highlights the critical reality that GenAI is poised to impact every stage of human cognitive and socioemotional development. G7 countries should lead the world by adopting developmentally-graded AI policies that reflect and adapt to the evolving scientific understanding of AI's impact on children. Since direct evidence on youth-AI interaction is still emerging, proactive AI governance is necessary, drawing on developmental science, research on youth screen impacts, early findings on GenAI use by young people, structured expert guidance, and international coordination. Youth adoption of GenAI is widespread, often compulsory or increasingly embedded in common tools such as search engines and social media platforms, and outpacing that of adults. Across G7 and non-G7 countries alike, children and adolescents are using GenAI for educational purposes, creativity, information-seeking (including to assist personal decision-making), entertainment, companionship, skill-building, and emotional support. Measuring these use-cases using common methods and nomenclature is described in this brief as a key priority for GenAI governance in child-facing contexts. The current evidence base is fragmented across countries, age bands, definitions of use, and research methods, making it difficult to compare findings or set priorities with confidence. A shared measurement infrastructure is therefore not only a research need, but a governance prerequisite.

This brief outlines essential "age-bands" enabling more granular discussions and more targeted action around the risks and benefits of GenAI. It is organized across four developmental periods: 0-3, 3-6, 6-12, and 12-18 years of age. Impacts are mapped specifically to these age-bands in a scientifically-informed manner. Research-derived insights from psychology and neuroscience link specific age-based AI use cases with specific impacts. This mapping is meant to represent a framework that reflects how developmental stage, use context, interaction pattern, frequency of use, adult mediation, and system design interact to shape risk and benefit. The purpose is not to treat every AI exposure as harmful or beneficial, but to identify where specific product features and use patterns may support development, where they may substitute for capacities still forming, and where expert consensus is needed to guide appropriate action.

This science-informed policy brief closes with a five item action agenda. This agenda includes improving measurement and transparency, defining developmental objectives in a manner reflecting ages and stages of childhood, building a research agenda around these objectives, and establishing international standards for research and best practices within a recurrent framework. It also calls for a standing international process capable of surfacing areas of scientific convergence, disagreement, and uncertainty over time, so that policymakers are not relying on isolated studies, anecdotal harms, or industry self-assessment alone. These recommendations are meant to ensure GenAI is governed not as a monolithic set of computer programs, but rather as a powerful and disruptive technology whose effects on children and teens will depend on age, context, and AI controllability and safeguards. Acknowledging the factors outlined in this brief will allow G7 countries to lead the world in deploying AI thoughtfully, regulating AI development in a granular and developmentally appropriate way capable of keeping children safe while expanding their potential.

iRAISE
International Research-driven Alliance for AI Serving Every child

1 . Context

Children under 18 make up nearly a quarter of the world's population and are the primary stakeholders in the expanding AI landscape to come. Decisions taken now about the role GenAI is designed to play in their lives will influence children's safety, cognition, emotion, social behavior, and civic capacity throughout their lifespan. GenAI systems are already acutely impacting teen lives: instances in which models have contributed to eating disorders, self-harm, psychosis amplification and, in the most tragic cases, suicide, are documented. The issue goes beyond exposure to harmful content to include how AI systems are trained and optimized, as well as how they interact dynamically with children over time. Evidence on AI's impact on child development is sparse due to the emerging nature of both the technology and the research field on its varied impacts. Despite that limitation, there is a strong need to incorporate early evidence and adjacent research into anticipating AI systems' impact and into their governance and their deployment around children. The central governance challenge is therefore to turn existing knowledge into usable priorities now, while building the research, measurement, and consensus infrastructure needed to update those priorities as systems, products, model policies, and patterns of child use evolve.

2. GenAI and Sensitive Periods of Development

Human development is characterized by critical windows in which specific forms of learning and environmental inputs are especially important. Generative AI (GenAI) can increasingly automate tasks traditionally requiring human cognition and due to its interactive nature and its growing ubiquity, this technology is uniquely positioned to influence children's cognitive, socioemotional, and behavioral trajectories across the globe. From birth into early adulthood, the brain and the psychological capacities it supports undergo rapid and sustained development that varies as a function of age and developmental stage. Consequently, children's engagement with GenAI should not be treated as a single, uniform exposure with consistent effects over time. The potential risks and benefits of GenAI use should be assessed through a developmental lens, with attention to the specific context and use case[1]. Decades of research in developmental psychology have demonstrated that healthy early childhood development largely depends on interaction with other humans, sensorimotor learning, and language-rich environments. Later childhood development places greater weight on skills such as literacy, executive function, peer learning, and creativity. During adolescence, there is a distinctive developmental imbalance: reward-sensitive and social systems mature earlier than the prefrontal systems needed for inhibition, long-term planning, and nuanced risk evaluation. In addition, adolescence is a period in which socialization, identity formation, and autonomy development are paramount, and relationships become more complex. Given the documented impacts of previous digital media on these processes, it is likely these developmental processes will be influenced by interactions with AI technology. This is why interactions with AI that may be lower-risk for an adult can be developmentally consequential for a child, and why the extent to which these interactions pose a risk depends on the child's age and the capacities that are still forming[1].



Implications for policymakers:

AI governance should be developmentally aligned, with rules, safeguards, and evaluation standards that reflect children's evolving capacities at different ages, rather than treating all minors as a single category.

3. Youth adoption of GenAI, Current evidence and the measurement imperative

People under 18 are adopting GenAI at a rapid pace. In 2025, in the United States, one in two teenagers aged 15–17 had accessed a GenAI application, with significant adoption also extending to children aged 10–12[2]. In the EU, Eurostat found that 63.8% of 16–24-year-olds used GenAI in 2025[3]. In the United Kingdom, 66.5% of 13–18-year-olds reported using GenAI in 2025, while the percentage of 13-18-year-olds reporting weekly or more frequent use grew from 31.1% to 45.6% over one year, indicating a potential shift toward greater reliance on AI among young users[4]. Beyond G7 countries, OECD cross-national data show substantially higher youth adoption in India, Brazil, and Indonesia than in several G7 economies[5].

Although these studies cannot be directly compared because they use different age bands, platform definitions, and sampling methods, they converge on a clear pattern: youth adoption is widespread, fast-moving, and increasingly embedded in everyday activities. Assistance with schoolwork, including homework, is the dominant use case across surveyed populations[4,6,7,]. Beyond education, young people use GenAI for entertainment and creative work, information-seeking, and writing support. A distinct and less-measured category is also emerging around AI use for social and emotional support, as well as companionship: 13.1% of US youth aged 12–21[2] reported using GenAI for mental health advice, and nearly 3 in 4 teens in the US report using AI for reasons including advice, emotional support, or asking sensitive questions[8].

Despite this rapid uptake and diversity of use-cases, there are currently no standardized measures for tracking psychiatric outcomes correlated with AI exposure, such as emergency department visits, suicide attempts, self-harm hospitalizations, or prodromal symptom amplification. Beyond these severe, more immediate psychiatric and physical harms, everyday exposures and their relationship to more chronic developmental, cognitive, emotional, or behavioral impacts also require measurement, yet efforts are not unified in language and method.



Implications for policymakers:

Young people are adopting GenAI at high rates, with potential implications for their cognitive and emotional development. Yet governments and researchers still lack a standardized, internationally accepted methodology for measuring GenAI use among minors. Current evidence remains fragmented across incompatible national surveys, inconsistent age bands, varied GenAI use cases, and limited longitudinal design, making it difficult to compare findings or draw reliable conclusions over time. A shared measurement standard is needed to support both policy action and research continuity. We cannot monitor what is not consistently measured.

4. GenAI opportunities and risks of harm at different stages of development

The tables below summarize the main opportunities and risks of harms that child development researchers identified across age groups, types of use, and typical patterns of exposure. They do not aim to provide an exhaustive list or literature review. Rather, they offer a developmental map and set of meaningful examples for policy conversations on GenAI and children. It is also not the case that the risks and opportunities outlined in this section are equally likely. The opportunities outlined here depend on the conditions under which GenAI is created, trained, fine-tuned, deployed, and governed. Opportunities are more likely to materialize when safety is treated as a prerequisite for benefit, guided by developmental science and informed by the technical specificities of AI systems.



0 to 3 years old



From birth to age 3, development is organized around **attachment** (the emotional bond with caregivers), **joint attention** (sharing focus with another person), early **language development**, and s**ensorimotor learning** (learning through action and response). Through contingency, the infant acts, another person responds, and the young child gradually learns trust, emotion regulation, communication, agency, and early mental models of how the world works[9-12]. These early achievements are the developmental foundation on which later language, self-regulation, neural organization, and social understanding depend. At this stage, AI may support development indirectly, primarily by helping caregivers respond more effectively to children's needs. Yet when these systems draw attention away from the child, mediate caregiver-child exchanges, or simulate responsiveness themselves, they risk interfering with the very developmental processes they are intended to support[12-16].

Opportunities	Risks of Harms
Caregiver-facing AI tools: *Baby monitors, cry recognition, sleep trackers, milestone apps, parenting assistants, assistants supported by GenAI models.*	
• **Caregiver support:** May help caregivers respond more quickly, reduce stress, and access useful information. Benefits are most plausible when the system remains a background aid that strengthens caregiver responsiveness rather than replacing attention, judgment, or clinical care. • **Self-regulation support:** May support short, bounded calming, transition, or sleep routines when used occasionally and without replacing human touch, movement, voice, or co-regulation. • **Early detection support:** May help identify possible early behavioral or conversational warning signs and suggest expert consultation when outputs are accurate, bounded, and verifiable.	• **Technoference:** AI-augmented devices can redirect caregiver attention away from infants during feeding, soothing, play, and other joint-attention moments. • **Over-monitoring:** Continuous tracking may normalize unnecessary data collection, increase caregiver anxiety, and reduce caregivers' opportunity to build confidence in their own observation, judgment, and tolerance for uncertainty. • **Clinical misdirection:** AI advice may be inaccurate or insufficient, especially when the system lacks access to symptoms, history, context, or risk factors. • **Postpartum mental health:** AI systems that simulate emotional support may delay clinical help-seeking, particularly when parents use them in moments of distress. They may also provide unhelpful or risky advice without access to undisclosed symptoms, history, or risk factors. These risks are heightened during the postpartum period, a time of increased vulnerability for mental health.

0 to 3 years old

Opportunities	Risks of Harms
Ambient AI-generated content: *AI-generated lullabies, white noise, music, visual patterns, screen-based soothing content supported by GenAI models.*	
• **Emotion regulation support:** May support short routines such as calming or sleep when used occasionally and without regularly replacing human touch, movement, voice, or co-regulation.	• **Passive stimulation:** May displace touch, movement, exploration, and other sensorimotor experiences that support early development. • **Interference with regulation:** Repeated reliance on AI-generated soothing may interfere with self-regulation and co-regulation, especially if caregivers come to depend on automated content as the default calming strategy. • **Misleading developmental claims:** Systems may be marketed as developmentally beneficial without sufficient evidence.
Responsive AI objects: *Toys or devices reacting to infant sounds or movement with human-like responses supported by GenAI models.*	
• **Caregiver support:** May provide short periods of engagement or soothing in constrained situations, especially during co-use with caregivers, especially when visual access to screens is not involved. Benefits to the child are likely indirect, situational, and derived from support of caregiver functions, rather than developmental.	• **Simulated social contingency and socioemotional disruptions:** Systems that mimic responsiveness may interfere with attachment-related processes and expose infants to simulated social contingency without the social/relational inputs development requires, producing the form of attachment without the function. Systems that are too engaging or that involve screens may increase physiological arousal and disrupt soothing and sleep. • **Cognitive distortion:** Repeated AI inputs may skew infants' early statistical expectations about social and sensory responses in the environment.

Implications for policymakers:

Across this age band, the central distinction is whether AI strengthens caregiver responsiveness or replaces elements of it. The same feature, such as monitoring or responsiveness, can support development when it helps a caregiver notice and respond, but create risk when the system itself becomes the source of stimulation or simulated interaction. The policy signal is that interaction design and use context matter more than content alone: infant-directed systems that mediate or simulate core relational processes should be treated differently from caregiver-support tools.

3 to 6 years old



Between ages 3 and 6, children make major gains in symbolic play (using one thing to stand for another), language skills, theory of mind (understanding that others have thoughts, feelings, and intentions different from one's own), and emotion labeling. These capacities support imagination, storytelling, early literacy, social understanding, and self-regulation. At the same time, children are still developing reality monitoring (distinguishing what is real from what is fictional or imagined), early source monitoring (tracking where information comes from), and early epistemic vigilance (judging whether information is reliable). They also readily engage in anthropomorphic interpretation (treating non-human voices or characters as if they have minds and feelings). Thus, early childhood is a time when children are especially sensitive to AI systems that are fluent, responsive, personalized, or emotionally expressive. Screen time increases during this age range, and AI is set to expand screen-based interactions and their impact on development. These features can exert different impacts; they can support language and play in adult-guided contexts, but they can also displace real world interactions and blur the boundary between fiction and reality, and confuse authority and relationships[1,12,17-20].

Opportunities	Risks of Harms
Voice-based AI and general assistants: *Smart speakers, voice assistants, conversational systems supported by GenAI models that are used to answer questions, translate, tell jokes, or provide entertainment.*	
• **Cognitive support:** May provide scaffolded, personalized feedback that supports language expansion and question-asking, especially when an adult is present to interpret, correct, and contextualize responses. May also support accessibility for children with some communication or learning needs or in multilingual environments.	• **Epistemic Distortion:** Children at this age have difficulty discerning the kinds of information that technologies like smart speakers are capable of reliably providing. They are still developing epistemic vigilance and source monitoring, and they may trust devices/agents based on familiarity alone (e.g., presence in their home). • **Mental models and Norms distortions:** AI systems providing confident but incorrect outputs, especially without source attribution, may be absorbed as true, and **inappropriate norms or language** may be repeated without understanding. • **Social interactions interference:** Frequent question-asking of GenAI assistants may displace question-asking to parents or other caregivers, who can provide more context and meaning-making in their responses. This may also shift child mental models regarding epistemic authority and the importance of context in conversational dynamics.

3 to 6 years old

Opportunities	Risks of Harms
AI-enabled educational and storytelling tools: *Story generators, reading and early numeracy companions, adaptive learning apps, drawing or creativity apps, and educational platforms supported by GenAI models.*	
• **Cognitive support:** May enrich language, narrative skills, symbolic play, and early literacy when co-used with adults who ask questions, explain vocabulary, and connect content to real-world experience. • **Creative support:** May stimulate early imagination when tools invite children to elaborate, retell, draw, act, or extend ideas rather than passively receive finished outputs.	• **Epistemic distortion:** Children may treat generated stories or explanations as literal, factual, or authoritative as reality monitoring is still immature and children may not reliably distinguish invented content from factual content. • **Cognitive interference:** Overreliance on rote or automated learning strategies may undermine play-based and discovery-oriented learning. • **Sensorimotor displacement:** Bypassing pencils, crayons, manipulatives, and physical materials may deprive children of tactile, proprioceptive, and kinesthetic feedback needed for fine motor development. • **Social-emotional disruption:** Highly polished or personalized outputs may reduce open-ended play, spontaneous storytelling, and meaning-making with adults or peers. • **Social interactions interference** by reducing opportunities for face-to-face and high quality relational routines like bedtime storytelling.
Character-based, companion-like, or embodied AI: *GenAI characters in games or apps; talking toys supported by GenAI models with persistent personas; GenAI-supported systems that remember the child, use emotional language, or simulate friendship; robots or interactive toys that respond to touch, movement, or simple commands.*	
• **Cognitive support:** May increase engagement and support symbolic play in narrow contexts when clearly framed as fictional and used with adults. May hold attention longer due to its interactive nature and the possibility of AI systems to match the companion AI with the child's demographic background.	• **Anthropomorphism and parasociality:** AI systems that simulate characters familiar to children may make the effects of anthropomorphic AI more salient and impactful. Anthropomorphic or "anthropomimetic" cues in character-based or companion-like AI, such as voice, name, conversational style, memory, praise, or emotional language, may encourage attachment to the system and strengthen parasocial tendencies.

3 to 6 years old

Opportunities	Risks of Harms
	These cues may operate at interface, agentic, or embodied levels of AI models. Stopping an interaction with a GenAI system, especially permanently, may also cause feelings of loss and sadness for children, especially when attachment is generated. • **Reality-boundary disruption:** At this stage of development, these systems may blur the boundary between fantasy and social reality, as children can interpret the system as having feelings, intentions, or a real relationship with them. • **Reduced social development practice:** These systems do not have a mind, psychological states, or genuine understanding, so interaction with them cannot provide the same rich practice in theory of mind, empathy, reciprocity, and negotiation that children develop through engagement with real people. Repeated use may therefore displace opportunities for these skills to develop and shape expectations of social interaction around relationships that are always available, highly agreeable, and one-sided. • **Over-structured play:** In embodied interactive toys, if the toy becomes overly directive or overly reactive, it may narrow play into stimulus-response loops rather than supporting symbolic and social play. Open-ended pretend play is important because it helps children practice representation, perspective-taking, and negotiation, and tools that over-structure play may reduce those opportunities.

3 to 6 years old

Opportunities	Risks of Harms
Ambient AI-generated content: *AI-generated videos, songs, stories, visual content, & GenAI assisted children's content streams.*	
• **Entertainment and self-regulation support:** May provide entertainment, novelty, and limited support for routines such as calming or transition periods, in a manner tailored to individual child and family needs.	• **Passive stimulation:** May increase passive consumption and displace active play, conversation, movement, and exploration. The attention-capturing nature of some GenAI video content may lead to more consumption of low-quality content by young children, which has been associated with developmental delays. • **Reality-monitoring disruption:** Highly realistic or personalized content may intensify confusion between fiction and reality. • **Interference with regulation:** Repetition, personalization, and optimization may narrow interests, and reduce curiosity, independent thinking, and self-directed exploration.



Implications for policymakers:

Across this age band, the key determinant of risk is whether AI remains a tool within adult-guided interaction or becomes a standalone source of explanation, entertainment, or social interaction. In some cases, the same design features that may present as an opportunity, such as fluency, memory, personalization, and emotional cues, can also increase risk by making outputs feel authoritative or relationally real. The policy signal is that benefits and harms are tightly linked to framing, guardrails, and design choices that ensure appropriate interactions and adult mediation, including co-presence, which can help children navigate GenAI interactions. Systems that preserve reality monitoring, open-ended play, and human interaction are more likely to support development, while systems that position themselves as explainers, soothing tools, companions, or social partners create a higher-risk profile, especially when used without adult mediation.

6 to 12 years old



Between ages 6 and 12, the earlier foundations of language, play, and social understanding crystallize into core functions for learning and socialization. Children consolidate literacy and numeracy, while working memory, executive function (planning, sustaining attention, organizing behavior, inhibiting impulses), and metacognition (monitoring understanding and adjusting strategy) become more deliberate and transferable across tasks. As their formal education evolves, children begin to build self-efficacy (the belief that effort can lead to success), epistemic vigilance, source monitoring, and the habits of checking, comparing, and revising that support independent learning and productivity throughout their education. At the same time, peer interaction becomes increasingly important for reciprocity, social problem-solving, and emotion regulation through interaction. With these growing skills, neurotypical children require less prompting and scaffolding from their parents, but secure family relationships remain an important source of resilience, meaning-making, and sense of self. This is also a key period for developing intrinsic motivation, creative self-efficacy, and frustration tolerance, because children are learning not only to complete tasks, but also to persist, think, make, and collaborate with increasing independence. GenAI usage is already more ubiquitous at this stage than it is from ages 0-3, with reported use-cases across homework, search, creativity, games, mobile learning apps, and peer communication. The majority of the 400,000 educational apps currently available today target this age group. Half of families in North America and China say their kids use learning apps multiple times a week. The developmental question is therefore whether AI use strengthens or weakens thinking, learning, and social abilities that are consolidating during this period[1,20-30].

For the remaining older age groups, the analysis is organized by usage context, reflecting the different ways young people are engaging, and likely to continue to engage, with GenAI systems. The mapping is therefore divided into three tables: education and learning, entertainment and creativity, and social and relational systems.

6 to 12 years old



Education & Learning

Opportunities	Risks of Harms
AI homework and learning assistants: *General-purpose models (e.g. ChatGPT, Copilot, Gemini), tutoring bots, math helpers, writing assistants, reading support tools, school-integrated GenAI features.*	
• **Cognitive support:** May support literacy, numeracy, executive function, and metacognition, by explaining concepts in different ways, generating practice opportunities and providing formative feedback that could help children revise and improve. • **Personalized learning:** May adjust pace, difficulty, or presentation, helping children sustain progress with core learning materials & goals. • **Early detection support:** Pattern recognition in performance may help identify possible learning difficulties earlier, but these signals require careful interpretation and should not be treated as diagnosis. • **Learning support:** May support learning when they keep children engaged in step-by-step reasoning and when children are trained on effective GenAI prompting beforehand.	• **Epistemic distortion:** Children in this age-range may presume AI outputs are authoritative, even though systems make factual and logical errors, hallucinate, produce deceptive responses, and stochastically steer conversations in directions not intended by the user. These risks are compounded by the complexity of effective GenAI prompting. Although AI systems are improving in many ways, they remain fundamentally stochastic, which makes them difficult to control and predict. So-called "hallucinations," deceptive responses, and more garden-variety errors do not simply reflect occasional malfunctions; they arise from the probabilistic way these systems generate outputs. It may therefore be challenging for young learners to manage this complexity, keep the GenAI system aligned with their task, and correctly assess AI outputs for accuracy, especially as these systems replace traditional fact-finding methods. • **Cognitive out-sourcing:** Children have limited self-regulated learning ability, making them less likely to successfully prompt, monitor, and correct general-purpose AI assistants. They may become over-reliant on AI for solving problems and making decisions as it becomes more accessible. • **Self-efficacy disruption:** Repeated reliance may weaken confidence in children's own skills and ideas. The risk may vary across neurodevelopmental profiles because the same support may scaffold one child while substituting for underlying skill development in another.

6 to 12 years old

Opportunities	Risks of Harms
AI-powered search and information tools: *GenAI search summaries, conversational search, answer engines, research assistants, school search tools with GenAI responses.*	
• **Epistemic development:** May be supported by helping children access information, formulate questions, compare explanations, and begin building habits of inquiry. May support early source evaluation and verification habits when adults or schools explicitly scaffold comparison across sources, evidence, and perspectives. • **Metacognition Support:** May strengthen metacognition by prompting children to notice what they do not yet understand, refine their questions, and seek clarification.	• **Cognitive outsourcing:** AI-generated answers may interfere with source monitoring, epistemic vigilance, and metacognition by presenting information as a single fluent output that collapses sources, masks uncertainty, and reduces visibility into provenance and evidence, as children in this age band are still developing those skills. • **Epistemic distortion:** GenAI outputs may obscure epistemic bias because children may not see which perspectives are included, excluded, or weighted. They may internalize seemingly coherent patterns of output as neutral or factual rather than constructed. • **Critical thinking disruption:** Repeated use over time may weaken habits related to epistemic cognition and critical thinking, including questioning, brainstorming, checking, comparing sources, identifying perspectives, weighing evidence, and noticing when one does not yet understand.

6 to 12 years old

Opportunities	Risks of Harms
AI study and organizational tools: *Summarizers, note-makers, flashcard generators, quiz creators, planners, homework management tools, text simplifiers.*	
• **Executive function support:** May support **executive function** and **metacognition** when the design works as a scaffold that helps children gradually learn to manage these processes more independently over time. This includes tools that make planning, sequencing, prioritizing, monitoring, and revision more visible, while progressively shifting responsibility back to the child. • **Self Regulation support:** May be especially useful for children who need more support with initiation, working memory, organization, or study routines.	• **Cognitive outsourcing:** The risk emerges when the design shifts from scaffolding to substitution. If the system automatically decides what matters, structures notes, generates questions, orders steps, and schedules work with little child input, it can replace the processes it is supposed to support. In that case, children get less practice in independent self-directed planning, prioritizing, working memory, sequencing, monitoring understanding, and adjusting strategy. • **Interference with executive functioning:** Children may get less practice in independent planning, prioritizing, working memory, sequencing, monitoring understanding, and adjusting strategy. Over time, the tool may become the default manager of the task rather than a temporary support the child gradually internalizes.
AI-powered interactive learning experiences: *Custom-built educational games, simulations, and interactive learning experiences supported by GenAI models. These include AI designed curricula, learning tasks, supports, and/or feedback where the learner does not directly use AI.*	
• **Personalized learning:** AI may be built into existing educational applications and select curriculum content, design learning activities, adjust examples, practice tasks, feedback, and difficulty based on learner performance to align with the zone of proximal development • **Healthy Engagement:** GenAI may generate or support educational games, simulations, and adaptive platforms by	• **Epistemic distortion:** GenAI may become the hidden basis for curriculum selection and learning activity design in popular educational apps already used in homes and schools. • **Developmental misalignment:** Rather than activities being designed by educators, curriculum specialists, and learning scientists, systems may generate or sequence content automatically, with limited transparency about the pedagogical

Opportunities	Risks of Harms
generating the games themselves, story prompts, scenarios, explanations, or challenges aligned with curricular goals. • **Educator Support:** Benefits may occur when expert learning designers use AI to more efficiently create structured pedagogical design, support active engagement with content, and encourage learners to explain, revise, and apply ideas.	model guiding those choices. This may lead to inaccurate, poorly sequenced, or developmentally inappropriate activities being presented as educationally sound. • **Platform-managed learning:** Over time, learning may shift from expert-designed instructional experiences toward platform-managed progression, engagement, and content generation.



Entertainment and creativity

Opportunities	Risks of Harms
AI creativity tools: *Image generators, music generators, story creators, video tools, design assistants, and creativity apps supported by GenAI models.*	
• **Creative support:** May support creative cognition by helping children generate ideas, explore alternatives, and work across forms of expression such as image, music, animation, or story-making. • **Accessibility support:** May unlock access to new creative media, such as image, music, animation, or story-making, including for children who might not otherwise be able to participate easily because of expressive, motor, or language-related difficulties. • **Scaffolding skills:** Benefits are strongest when the system prompts elaboration, revision, comparison of options, or development of an initial idea rather than simply producing the result.	• **Motivational interference:** Repeated reliance on AI-generated outputs may interfere with the development of intrinsic motivation (engaging in a task for its own sake), creative self-efficacy (belief in one's ability to create through effort), productive struggle, frustration tolerance (enabling persistence when a task is difficult or imperfect), and creative skills themselves. When GenAI systems produce faster and more polished outputs than the child can produce alone, it may shift motivation away from the process of making and towards the immediate quality of the outcome, and likewise shift the child's role in the creative process from "creator" to "director".

6 to 12 years old

Opportunities	Risks of Harms
	• **Creative development disruption:** Creativity develops through generating ideas, testing possibilities, revising, tolerating imperfection, and seeing one's own effort lead to improvement. Physical art makes this process visible through repeated cycles of planning, making, observing, adjusting, and trying again. When AI performs too much of this iterative work, children may lose opportunities to practice creative exploration, persistence, and flexible problem-solving, which also support broader reasoning skills. • **Interference with self-regulation:** Over time, creativity-related use cases for GenAI may reduce willingness to persist through uncertainty, lower time investment in practicing creative skills, and make children more likely to rely on the system when their own ideas feel slower, weaker, or incomplete.
AI embedded in games and entertainment platforms: *In-game GenAI assistants, GenAI-driven NPCs, personalized quest or reward systems, GenAI chat features in games, recommendation systems, and adaptive entertainment content supported by GenAI models.*	
• **Cognitive support:** May support problem-solving (suggesting different strategies and tactics), cognitive flexibility, and goal-directed behavior when systems require children to plan, test, and adjust actions to achieve an outcome, or otherwise pursue goals with delayed gratification. • **Personalized learning:** Adaptive systems may maintain an appropriate level of challenge, supporting attention regulation and persistence when difficulty is calibrated to the child's level.	• **Interference with self-regulation:** Systems optimized for engagement can shape attention, impulse control, and reward processing while children are still developing sustained attention, delay of gratification, and disengagement from rewarding stimuli. • **Reward loop reinforcement:** Personalized rewards, continuous feedback, and always-available interaction can reinforce immediate reinforcement and reduce practice in disengagement, waiting, and self-regulation. • **Attention and disengagement disruption:** Repeated exposure to optimized reward loops may bias attention toward high-stimulation environments and strengthen patterns of use that persist into adolescence.

6 to 12 years old

Opportunities	Risks of Harms
Embodied or interactive AI toys and robotics *Programmable robots, STEM kits with AI features, interactive toys with adaptive responses, connected toys that respond to commands or challenges*	
• **Cognitive support:** May support planning, sequencing (a core part of executive function), problem-solving, and early computational thinking. • **Scaffolding skills:** Rule-based and goal-oriented play can reinforce persistence, trial-and-error learning, and collaboration when used with peers or adults.	• **Over-structured play:** If interaction becomes overly guided or optimized, it may reduce opportunities for open-ended problem-solving and self-directed exploration. • **Motivational disruption:** Systems that provide too much assistance or immediate correction can limit productive struggle and weaken persistence. • **Social-development expectations**: Highly responsive or personalized systems may shape expectations toward systems that adapt to the child rather than requiring the child to adapt, which matters for both learning and peer interaction.

6 to 12 years old



Social and relational systems

Opportunities	Risks of Harms
Character-based or companion-like AI in apps and games: *GenAI chatbot companions, persistent conversational personas in children's apps, GenAI systems that remember past exchanges, use emotional language, or simulate friendship.*	
• **Social-emotional support:** Potential benefits are narrow and should not be assumed. Under highly conservative safeguards, brief and structured interactions may support limited verbal participation, turn-taking, or role-based exchange, but only when used alongside trusted adults and clearly framed as a tool. The system should remain tool-bounded, avoid anthropomorphic cues or false claims of humanhood, sentience, emotions, or relationship, and support transfer into real-world social interaction rather than positioning itself as a social partner.	• **Anthropomorphic and socio-affective pull:** Memory, praise, emotional language, or apparent availability can make the character feel socially significant and strengthen parasocial tendencies over time, especially when embedded in ongoing play, progress loops, and re-engagement. Companionate and character conversational GenAI systems have already contributed to serious harms to older children, such as suicide and self-harm, and many platforms age-restrict access to companionate GenAI systems due to their potential to disrupt social and emotional functioning. • **Social expectation distortion:** Because these systems are optimized to maintain interaction, they may offer a simplified social experience that is highly responsive, predictable, and low in mutual demand, in turn impacting expectations of social relationships and ability to navigate dynamic social situations with other people. • **Reduced social-development practice:** Repeated exposure may reduce opportunities to practice empathy, reciprocity, conflict repair, and social problem-solving, by displacing time spent engaging in meaningful complex and socially rich human interactions and relationships. • **Identity disruption:** Norms, values, and expectations expressed by GenAI systems may influence identity formation if children are repeatedly exposed to them.

6 to 12 years old

Opportunities	Risks of Harms
Embodied companion AI and social robots: *Robotic pets, talking or emotionally expressive toy robots, connected toys that greet the child, remember preferences, initiate conversation, or present themselves as caring companions.*	
• **Limited structured interaction support**: Potential benefits are narrow and should not be assumed. Under highly conservative safeguards, GenAI-enabled social robots may support turn-taking, simple routines, verbal responses, or repeated guided activities, and their physical presence may help sustain attention or engagement. These effects depend on design, use, and framing, and are most plausible when the robot remains tool-bounded, avoids false claims of humanhood or sentience, and supports real-world social interaction rather than positioning itself as a relational partner.	• **Social replacement**: May increase the salience and sense of normalcy within the interaction, making the system feel more socially significant, familiar, and dependable over time. • **Reduced social-development practice**: The concern is less whether the child believes the system is alive and more how repeated interaction may shape reciprocity, perspective-taking, social flexibility, parasocial attachment, and conflict repair. • **Unrealistic social expectation:** Over time, repeated use may shape expectations of interaction around predictability, responsiveness, and control, while displacing human relationships as well as opportunities to build the flexibility and negotiation skills that become increasingly important in this period. • **Interference with self-regulation**: Because the robot adapts to the child more than the child must adapt to it, it may reduce opportunities to practice mutual adjustment. Repeated use may shape expectations around predictability, responsiveness, and control while displacing human relationships and negotiation skills.
AI-mediated peer and social interaction: *AI chat features in shared apps, collaborative AI tools used among classmates, AI-assisted messaging, avatar systems, social platforms with AI-generated prompts or replies.*	
• **Communication support:** May support participation in peer interaction by scaffolding communication planning, response structure, turn-taking, and information exchange, but only when AI remains a limited scaffold rather than a source of technoference.	• **Social-emotional disruption:** Peer interaction at this age supports reciprocity, perspective-taking, conflict repair, social problem-solving, and emotion regulation in interaction. AI may create social technoference when it mediates parts of peer exchange that children would otherwise need to manage themselves.

6 to 12 years old

Opportunities	Risks of Harms
• **Social-cognitive support:** May help children practice perspective-taking, such as anticipating how a message may be received, with greatest potential for youth with neurodevelopmental disorders when used as a bounded support for real peer interaction, rather than a substitute for it.	• **Reduced social problem-solving:** If the system generates replies, structures interaction, or smooths over misunderstanding and disagreement, children may get less practice interpreting intentions, managing ambiguity, revising communication, and negotiating mutual understanding. • **Cognitive outsourcing and over-reliance:** AI may become the center of the conversation and increase reliance on external systems to manage social complexity.



Implications for policymakers:

Across this age band, the central distinction is whether AI acts as a scaffold for learning and social development or as a substitute for them. The same features that make systems useful, such as personalization, step-by-step guidance, immediate feedback, automation, and social mediation, can also reduce cognitive effort, weaken self-regulation, and displace peer interaction. The policy signal is that design features and default settings are decisive: they determine whether AI helps children build executive function, metacognition, motivation, and social-cognitive skills, or takes over too much of the cognitive and social work children need to practice themselves.

12 to 18 years old



From 12 to 18, development continues to build on earlier foundations but shifts toward the consolidation of intellectual autonomy, self-regulation, and a more stable sense of self. This is a period of substantial neural growth, myelination, and reorganization, with neural pathways and interconnections continuing to consolidate in ways that shape future adult functioning. Adolescents refine higher-order executive control, metacognitive control, epistemic judgment (evaluating evidence, bias, and competing claims), and long-term planning, even as reward and social salience remain high. They are also forming creative identity, self-authorship, relational autonomy, the capacities for intimacy and boundary-setting, and an authentic interpersonal voice. This is a stage in which young people are not only learning skills, but also beginning to own their reasoning, values, relationships, and modes of expression.

Surveys suggest that AI is also far more ubiquitous among this age group[2-6,8,31]: adolescents use it more independently and across more domains, including learning, research, creativity, games, advice, emotional support, and communication[1,8,12]. Because adolescents use devices more independently, AI use may also extend into private or late-night contexts, including homework, entertainment, gaming, advice-seeking, or emotional support. This raises additional concerns around sleep displacement, nighttime rumination, and reduced adult visibility into patterns of use. The salient developmental question is therefore how repeated AI interaction may shape adolescents' judgment, identity, self-authorship, and models of support and relationship over time[32-38].

This age band also requires increasing attention to adolescent heterogeneity. Young people with different neurodevelopmental profiles, prior mental health difficulties, trauma histories, social isolation, or limited offline support may interact with AI in different ways and may be more exposed to reliance on social or relational systems. Governance therefore needs both universal safeguards for all adolescents and more targeted protections for higher-risk contexts and users.



Education & Learning

Opportunities	Risks of Harms
AI learning, writing, and reasoning assistants: *General-purpose models, advanced tutoring systems, writing assistants, coding tools, exam preparation tools supported by GenAI models.*	
• **Cognitive support:** May support advanced reasoning, argumentation, and metacognitive control by helping adolescents test ideas, compare perspectives, and refine thinking. • **Autonomy support:** Benefits are less about acquiring basic skills and more about strengthening intellectual autonomy: the ability to plan, evaluate, and revise one's own reasoning. • **Self-regulation support:** May support self-regulated learning by helping adolescents structure complex tasks, identify gaps in understanding, and iterate on their work. • **Discipline-specific support**: May support writing, coding, or scientific reasoning when the system prompts analysis, justification, and revision rather than providing final outputs. • **Identity support:** May provide a private space to explore questions linked to identity formation, including gender, sexuality, religion, political beliefs, values, and belonging. For some adolescents with limited safety or support offline, access to information, language, and nonjudgmental support may reduce isolation.	• **Cognitive outsourcing:** The main risk is a shift from developing independent reasoning to assisted reasoning at a stage when adolescents are consolidating their ability to think, judge, and produce work on their own. • **Cognitive over-reliance:** If systems generate arguments, structure essays, solve problems, or complete complex tasks, adolescents may get less practice evaluating evidence, constructing arguments, weighing alternatives, and defending positions. • **Poor epistemic practices:** Some systems encourage students to write first and attach evidence afterward or to make AI-generated text sound more human, in ways that obscure authorship. This confuses academic writing as a learning process with the mere production of a finished output. Over time, such tools may normalize misrepresentation, weaken source-based reasoning, and undermine epistemic judgment. • **Cognitive overload:** Endless information, suggestions, corrections, and alternatives may increase mental load and decision fatigue, especially for adolescents still developing prioritization and self-regulation. • **Interference with self-regulation:** Highly structured reasoning, immediate answers, or continuous guidance may increase reliance on external systems to manage thinking processes that should become internalized, such as deciding what matters, recognizing uncertainty, and determining when an answer is sufficient.

Opportunities	Risks of Harms
	• **Motivational disruption:** Immediate feedback, adaptive prompts, and frictionless assistance may reduce opportunities for sustained attention, delayed gratification, and effortful problem-solving, and may shape expectations that complex thinking should be fast, supported, and externally guided. • **Identity disruption:** If AI becomes a primary source of explanation, validation, or production, it may blur the link between effort and outcome and make it harder to build stable competence, ownership, and authorship. This risk may be heightened when adolescents use AI to explore sensitive or minority identities, including questions related to gender, sexuality, religion, politics, or belonging. In these contexts, repeated validation, personalization, or directive guidance may give the system disproportionate influence over self-understanding, especially when offline support is limited.
AI search, research, and information synthesis tools: *GenAI search engines, summarization tools, research assistants, and academic support tools supported by GenAI models.*	
• **Epistemic development:** May be supported by giving adolescents access to in-depth, specialized knowledge that may otherwise be less accessible in their immediate environment. • **Self-regulation support:** May broaden exposure to complex topics, multiple perspectives, and domain-specific reasoning, supporting exploration and independent study. • **Metacognition and judgment support:** Benefits are strongest when tools help adolescents formulate questions, compare perspectives, evaluate arguments, refine their own positions, surface assumptions, outline competing explanations, and prompt justification and revision which all support metacognitive control and independent judgment.	• **Epistemic distortion:** The main risk is not only mislearning, but the shaping of how knowledge is evaluated and trusted. AI systems often present information as a single fluent synthesis, obscuring uncertainty, provenance, and conflicting perspectives. • **Reduced critical thinking:** Adolescents may rely on coherence and fluency as signals of truth rather than critically evaluating evidence, comparing sources, and identifying assumptions and bias. • **Bias feedback loops:** Because sources and selection processes are often invisible, adolescents may not see which perspectives are included, excluded, or weighted. This can make biased or partial outputs appear neutral, while repeated

Opportunities	Risks of Harms
AI search, research, and information synthesis tools: *GenAI search engines, summarization tools, research assistants, and academic support tools supported by GenAI models.*	
• **Personalized learning:** May reduce barriers linked to geography, resources, or institutional access, contributing to greater equity in access to knowledge.	personalization may reinforce existing assumptions and narrow exposure to competing viewpoints. • **Interference with epistemic judgment:** Repeated reliance on synthesized outputs may reduce practice in independent research, argument evaluation, and epistemic judgment, shaping habits of knowing toward acceptance of well-formed answers rather than active interrogation. This is particularly important at a stage where adolescents are developing the capacity to form and defend their own views.
AI study and organizational tools: *Summarizers, note-makers, flashcard generators, quiz creators, planners, homework management tools, and text simplifiers supported by GenAI models.*	
• **Executive function support:** May support consolidation of executive function and metacognitive control by helping adolescents manage increasingly complex and self-regulated workloads. At this stage, the goal is to support internalization of planning, prioritization, sequencing, and monitoring across longer time horizons and multiple demands. • **Autonomy support:** Benefits are strongest when the system makes these processes visible while progressively requiring the adolescent to take ownership of decisions and strategy use.	• **Interference with self-regulation**: The risk emerges when the system continues to act as an external manager rather than supporting the transition to independent control. • **Cognitive outsourcing**: If the tool selects what matters, structures information, determines priorities, and manages sequencing or timing, adolescents may gain less practice in planning, prioritization across competing goals, working memory coordination, and metacognitive monitoring. • **Autonomy disruption:** Key processes may remain externally supported rather than internalized, delaying the ability to independently organize, evaluate, and adapt one's own work.



Entertainment and creativity

Opportunities	Risks of Harms
AI creative and production tools: *Advanced image, video, music, and writing tools, content creation platforms, design and editing assistants supported by GenAI models.*	
• **Creative support:** May support the development of creative identity and advanced production skills by enabling adolescents to work across media, iterate quickly, and test ideas at higher levels of complexity. • **Cognitive support:** May support creative planning, refinement, and evaluation by helping adolescents compare alternatives, develop a style, and produce more complex outputs. • **Accessibility support:** May expand access to creative fields that would otherwise require technical skills or resources. Benefits are strongest when the system supports iteration, decision-making, and authorship.	• **Creativity disruption:** The main risk is a shift in how creative authorship and mastery develop. When systems generate consistently more polished outputs than self-produced work, adolescents may rely more on the system for production and get less practice in creative decision-making, iteration, and skill-building. • **Harmful misuse:** Because these tools can generate convincing text, images, audio, video, code, or synthetic identities at scale, adolescents may cause serious harm to others before fully grasping the legal, ethical, or interpersonal consequences. • **Victimization pathways:** Misuse may include impersonation, fraud, cyberbullying, non-consensual sexualized deepfakes, and other reputational or social harms. • **Motivational disruption:** Repeated reliance may interfere with creative self-efficacy and intrinsic motivation and make it harder to form a stable sense of personal style or ownership. • **Identity disruption:** The concern is not only reduced effort, but a weakened link between intention, process, and outcome, which is central to creative identity formation.

Opportunities	Risks of Harms
AI embedded in games, platforms, and content ecosystems: *AI-driven NPCs, adaptive content feeds, recommendation systems, AI chat in games, & immersive environments supported by GenAI models.*	
• **Problem-solving:** May support strategic thinking, complex problem-solving, and goal-directed behavior in environments that require planning, adaptation, and coordination over time. • **Social support:** May provide lower-stakes spaces to explore alternatives, test strategies, or rehearse roles and decisions, supporting perspective-taking and role experimentation when bounded and not replacing real-world engagement.	• **Interference with self-regulation:** The main risk is the shaping of attention, reward processing, and habit formation at a stage of heightened reward sensitivity and still-developing impulse control. • **Reward loop reinforcement:** Systems optimized for engagement maximization through personalization and adaptive reward loops may reinforce immediate reinforcement and reduce practice in disengagement and sustained attention. • **Habit formation:** May influence preference formation and time allocation, biasing adolescents toward high-stimulation, continuously responsive environments and away from activities requiring sustained effort without immediate reward. • **Overuse risk:** Gambling dynamics supported by AI systems within games may contribute to dysregulation and overuse.



Social and relational systems

Opportunities	Risks of Harms
Companion-like AI and relational systems: *General-purpose Large Language Models (LLMs) used for advice, emotional support, or ongoing conversation; chatbot companions; emotionally responsive AI; persistent personas; and systems designed or used as relational partners that are supported by GenAI models.*	
• **Identity support:** May support self-reflection and articulation of internal states, particularly when adolescents are trying to make sense of emotions, decisions, or interpersonal situations. This benefit should be treated cautiously and is most plausible when the system remains clearly framed as a tool rather than a source of identity validation or relational authority. • **Social-emotional support:** In bounded use, these systems may help adolescents externalize thoughts, rehearse perspectives, structure reflection, and support awareness of emotions and deliberation before action. These uses should remain limited, non-relational, and oriented toward reflection rather than ongoing emotional reliance. • **Support access:** For adolescents with limited access to human support, bounded and well-designed systems may reduce isolation, provided they connect users to human support when needed and do not simulate intimacy, dependency, exclusive understanding, or a substitute relationship.	• **Social replacement and emotional dependency:** AI companion systems may problematically foster intimacy, trust, and feelings of friendship or romance in adolescent users. Because these systems are always available, predictable, agreeable, and non-reciprocal, they can shift expectations of relationships toward immediacy, control, and low interpersonal demand. This may normalize problematic expectations around control and agreeableness in relationships. Greater reliance on AI for companionship or emotional support has also been associated with poorer mental health outcomes, raising concern that these systems may amplify vulnerability. • **Relational development disruption:** GenAI systems can simulate understanding without having genuine stakes, vulnerability, or responsibility in the interaction. These are central to how adolescents learn mutuality, emotional risk-taking, negotiation, repair, and boundary-setting in real relationships. Repeated reliance on AI companionship may therefore narrow the range of relational experiences adolescents practice and shape expectations of closeness around predictability, availability, and control. • **Unhealthy norm formation:** By mirroring or validating problematic framings, AI systems may reinforce harmful norms such as sexism, racism, ableism, conspiratorial thinking, or discriminatory beliefs, particularly when adolescents experience the system as socially meaningful or authoritative.

Opportunities	Risks of Harms
	• **Mental health risk amplification:** Mental health concerns may emerge from problematic interactions with AI companions and similar systems, and risks become more acute when adolescents seek support during crisis or clinically vulnerable states. AI systems may fail to reliably recognize or respond to suicidal ideation, self-harm behavior, eating-disorder behaviors, psychosis-related beliefs, or other severe clinical risks. In crisis or vulnerable states, simulated support, excessive validation, or overly specific guidance may intensify distress or harmful beliefs rather than connect the young person to appropriate human or clinical support. • **Emotion regulation disruption:** When AI systems become part of adolescents' emotion regulation or support-seeking strategies, repeated reliance may shape how they manage distress, validation, and connection. Over time, this may affect how adolescents tolerate relational uncertainty, seek human support, and construct expectations of closeness.
AI-mediated social interaction: *GenAI-assisted messaging, GenAI-generated replies, social platforms with GenAI prompts or feedback, and collaborative GenAI platforms deployed in peer contexts.*	
• **Communication support:** May support deliberate communication in contexts requiring planning, tone management, or coordination. • **Self-regulation support:** When used within reasonable constraints, these tools may help structure responses, support communication planning, and allow adolescents to reflect before engaging. • **Social-emotional support:** May support more intentional interaction in complex and mature social environments including friendships, group dynamics, and romantic interactions. These benefits are likely to be greater for adolescents with specific neurodevelopmental disorders than for neurotypical adolescents.	• **Autonomy disruption:** The developmental task is to develop an authentic interpersonal voice and the ability to manage ambiguity, vulnerability, and social risk. AI may shift communication toward more optimized but less self-authored interaction. • **Self-expression displacement:** If systems shape tone, content, or timing of responses, adolescents may get less practice in self-expression, boundary-setting, and negotiation of meaning, while becoming more anxious about producing socially "perfect" communication. • **Social-emotional disruption:** Reliance on AI to manage social uncertainty, impression management, and conflict may reduce practice in the very communication skills central to identity, belonging, and relational positioning.

12 to 18 years old

Opportunities	Risks of Harms
	Victimization pathways: GenAI-facilitated nudification photo generators offer another pathway for youth victimization that is commonly used in this age range.

Implications for policymakers:

Across this age band, the key distinction is whether AI supports the development of autonomy, identity, and judgment, or substitutes for these capacities while they are still consolidating. The same features that may unlock value, such as fluency, personalization, memory, responsiveness, can also compress effort, weaken independent judgment, intensify reliance, and shape expectations of attention and relationships. The policy signal is that governance should focus on design choices, defaults, and repeated interaction patterns, because these are what determine whether AI supports adolescent development or takes over developmental work that young people need to practice themselves. This is especially important for adolescents with neurodevelopmental differences, mental health vulnerabilities, social isolation, trauma histories, or limited offline support, who may be more exposed to reliance on adaptive, relational, or always-available systems.

5. Action agenda: Priority areas for AI policy and governance

Across age bands and use contexts, this mapping surfaces a consistent governance implication: the developmental impact of GenAI depends less on product category alone than on the capacities children are still building, the role the system is designed to play, and the conditions under which repeated interaction occurs. Potential benefits are most plausible when AI remains a bounded tool that scaffolds learning, creativity, communication, or reflection while preserving human mediation, effort, uncertainty, and social practice. Risks of harm increase when systems substitute for emerging capacities, automate too much cognitive or relational work, obscure sources and uncertainty, optimize engagement, simulate social understanding, or position themselves as companions, authorities, or sources of emotional reliance. The policy challenge is therefore to move from broad concern about minors and AI toward developmentally specific standards that can distinguish supportive scaffolding from harmful substitution. The next step is to translate this developmental map into practical priorities for product design, evaluation, research, and governance.

- **Dedicated work should clarify what shared measurement and monitoring infrastructure is needed** to establish common standards for age bands, AI use categories, exposure, and intensity measures. This infrastructure should involve longitudinal tracking of evolving model dynamics and child usage patterns, so that youth AI use can be compared systematically over time, across products, and across contexts. This is a foundational governance requirement. Without standardized measurement, it will remain impossible to distinguish broad adoption from repeated reliance, short-term experimentation from sustained use, or ordinary use from developmentally significant patterns of exposure. Measurement standards should be developed through multilateral coordination and applied consistently across jurisdictions. They should also be paired with workforce training, so that healthcare professionals and educators know how to ask about AI use, identify concerning patterns, and distinguish ordinary experimentation from reliance, distress, or developmentally significant use.

- **Define developmental AI safety objectives by age band**. Some insights about youth AI usage are general; for example, co-use with supervising adults generally scaffolds youth AI usage across all age bands. Nonetheless, many safety objectives and considerations must be specified by age and developmental stage. A structured expert process should define what constitutes safer AI system behavior with reference to the capacities that matter at each developmental stage: caregiver responsiveness and contingency for ages 0–3; reality monitoring and adult mediation for 3–6; executive function, metacognition, motivation, and peer interaction for 6–12; and autonomy, epistemic judgment, identity formation, and relational autonomy for 12–18. These objectives should also be informed by clinical surveillance and input from frontline professionals, who may identify emerging harms early. Translating these developmental concepts into operational safety objectives, product evaluation criteria, and, where appropriate, enforceable standards is a prerequisite for coherent product regulation.

- **Define what forms of transparency and independent audit requirements are necessary for researchers, caregivers, educators, companies, and public authorities**. This should cover how memory and personalization are applied; how sources are selected or synthesized; whether learning content and activities are AI-generated or designed by learning experts; how uncertainty is signaled; what re-engagement mechanisms are used, especially features associated with compulsive or prolonged use, such as intermittent reinforcement; how relational and anthropomorphic cues are designed and monetized; what crisis-response protocols apply when systems detect acute mental health risk, including detection thresholds, response scripts, and escalation pathways; and what safeguards apply to minors. Transparency should be actionable, accessible, and usable by regulators, researchers, schools, caregivers, and civil society, not only by legal or technical specialists. It should also be clear when transparency must be backed by mandatory independent third-party audits of real system behavior across repeated interaction, crisis-response scenarios, and product updates, rather than provider self-reporting or one-off point-in-time review.

- **Commission and fund a targeted research agenda on developmental AI design thresholds**. A coordinated, publicly funded research agenda is needed to determine which design features are beneficial under which conditions, and at what point they become developmentally harmful. Priority areas should include: AI model capacity, interpretability, and alignment; children's understanding and perceptions of AI; how to ensure AI scaffolds rather than substitutes for cognitive and social development; whether and under what conditions AI-generated learning content and activities can be developmentally appropriate and educationally effective; how relational and anthropomorphic design should be defined and governed; how engagement optimization creates developmental risk; what age-appropriate defaults and high-sensitivity safeguards should look like in practice; and where human mediation remains developmentally necessary and should be protected by policy. Coordination between sectors will increase the speed and success of these efforts. The objective is to produce a safer and more developmentally appropriate landscape of child AI use, with shared definitions, operational tests, risk indicators, and age-sensitive thresholds suitable for research, product review, procurement decisions, and regulatory oversight. Youth should be involved in this research where appropriate, with safeguards that reflect age, vulnerability, consent, and the sensitivity of the questions being studied.

- **Release a recurring international synthesis report on AI and child development**. A standing international report, updated on a two-year cycle, should synthesize the state of the evidence, identify areas of emerging consensus, track shifts in models, products, and use patterns, and set successive rounds of research and policy priorities. Given the pace of product change, this should be paired with an annual rapid evidence brief focused on emerging harms, shifting use patterns, and urgent governance signals. This tiered structure would combine deeper scientific assessment with faster identification of product, use, and harm signals. To serve its governance function, the report must be internationally comparative, cross-sectoral, and institutionally independent while integrating expertise across developmental science, product analysis, education, and regulatory practice. This would provide a durable common reference point for governments, regulators, researchers, schools, and industry, and address the current fragmentation of evidence and agenda-setting that limits coordinated policy action.

References

1. Neugnot-Cerioli, M. & Laurenty, O. M. The Future of Child Development in the AI Era. Cross-Disciplinary Perspectives Between AI and Child Development Experts. Preprint at https://doi.org/10.48550/ARXIV.2405.19275 (2024).
2. Maheux, A. J. et al. Generative Artificial Intelligence Applications Use Among US Youth. JAMA Netw Open 9, e2556631 (2026).
3. Eurostat. 64% of 16-24-year-olds used AI in 2025. Eurostat News, European Commissionhttps://ec.europa.eu/eurostat/web/products-eurostat-news/w/edn-20260210-1 (2026).
4. Picton, I., Clark, C. & Bonafede, F. Young people's use of generative AI to support literacy in 2025. (2025).
5. OECD. How Do People Experience New Technologies and Generative AI?: Insights from a Few Countries Worldwide. https://www.oecd.org/en/publications/how-do-people-experience-new-technologies-and-generative-ai_49b8d10e-en.html (2025) doi:10.1787/49b8d10e-en.
6. Freeman, J. Student Generative AI Survey 2025. (2025).
7. Madden, M., Calvin, A., Hasse, A. & Lenhart, A. The Dawn of the AI Era: Teens, Parents, and the Adoption of Generative AI at Home and School. San Francisco, CA: Common Sense. (2024).
8. McBain, R. K. et al. Use of Generative AI for Mental Health Advice Among US Adolescents and Young Adults. JAMA Netw Open 8, e2542281 (2025).
9. Gelman, S. A. Learning from Others: Children's Construction of Concepts. Annu. Rev. Psychol. 60, 115–140 (2009).
10. The Cambridge Handbook of Cognitive Development. (Cambridge University Press, 2022). doi:10.1017/9781108399838.
11. Meyer, M. et al. How educational are "educational" apps for young children? App store content analysis using the Four Pillars of Learning framework. Journal of Children and Media 15, 526–548 (2021).
12. Roseberry, S., Hirsh-Pasek, K. & Golinkoff, R. M. Skype Me! Socially Contingent Interactions Help Toddlers Learn Language. Child Development 85, 956–970 (2014).
13. Schmidt, M. E., Pempek, T. A., Kirkorian, H. L., Lund, A. F. & Anderson, D. R. The Effects of Background Television on the Toy Play Behavior of Very Young Children. Child Development 79, 1137–1151 (2008).
14. Kirkorian, H. L., Pempek, T. A., Murphy, L. A., Schmidt, M. E. & Anderson, D. R. The Impact of Background Television on Parent–Child Interaction. Child Development 80, 1350–1359 (2009).
15. Goldstein, M. H., Schwade, J. A. & Bornstein, M. H. The Value of Vocalizing: Five-Month-Old Infants Associate Their Own Noncry Vocalizations With Responses From Caregivers. Child Development 80, 636–644 (2009).
16. Goldman, E. J., Baumann, A.-E., Pare, L., Beaudoin, J. & Poulin-Dubois, D. Children's attribution of mental states to humans and social robots assessed with the Theory of Mind Scale. Sci Rep 15, 16357 (2025).
17. Wang, Z. Theory of mind and children's understanding of teaching and learning during early childhood. Cogent Education 2, 1011973 (2015).
18. Brosseau-Liard, P., Cassels, T. & Birch, S. You Seem Certain but You Were Wrong Before: Developmental Change in Preschoolers' Relative Trust in Accurate versus Confident Speakers. PLoS ONE 9, e108308 (2014).
19. Scofield, J. & Behrend, D. A. Learning words from reliable and unreliable speakers. Cognitive Development 23, 278–290 (2008).
20. Bonawitz, E. et al. The double-edged sword of pedagogy: Instruction limits spontaneous exploration and discovery. Cognition 120, 322–330 (2011).

21. Roberts, K. P., Wood, K. R. & Wylie, B. E. Children's ability to edit their memories when learning about the environment from credible and noncredible websites. Cogn. Research 6, 42 (2021).
22. Armitage, K. L. & Gilbert, S. J. The nature and development of cognitive offloading in children. Child Development Perspectives 19, 108–115 (2025).
23. Chen, A. et al. Unpacking help-seeking process through multimodal learning analytics: A comparative study of ChatGPT vs Human expert. Computers & Education 226, 105198 (2025).
24. Goldberg, E. & Magen, H. Cognitive offloading reduces internal memory processing in children. Sci Rephttps://doi.org/10.1038/s41598-026-44574-6 (2026) doi:10.1038/s41598-026-44574-6.
25. Best, J. R. Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. Developmental Review 30, 331–351 (2010).
26. Van Loon, M., Orth, U. & Roebers, C. The structure of metacognition in middle childhood: Evidence for a unitary metacognition-for-memory factor. Journal of Experimental Child Psychology 241, 105857 (2024).
27. Mills, C. M. Knowing when to doubt: Developing a critical stance when learning from others. Developmental Psychology 49, 404–418 (2013).
28. Mascaro, O. & Sperber, D. The moral, epistemic, and mindreading components of children's vigilance towards deception. Cognition 112, 367–380 (2009).
29. Beghetto, R. Creative Self-Efficacy: Correlates in Middle and Secondary Students. Creativity Res. J. 18, 447–457 (2006).
30. Internet Matters. Me, Myself and AI Research Understanding and Safeguarding Children's Use of AI Chatbots. https://www.internetmatters.org/hub/research/me-myself-and-ai-chatbot-research/ (2025).
31. Pew Research Center. How Teens and Parents Approach Screen Time. (2024).
32. Casey, B. J., Getz, S. & Galvan, A. The adolescent brain. Developmental Review 28, 62–77 (2008).
33. Cohen, A. O. et al. When Is an Adolescent an Adult? Assessing Cognitive Control in Emotional and Nonemotional Contexts. Psychol Sci 27, 549–562 (2016).
34. Rapee, R. M. et al. Adolescent development and risk for the onset of social-emotional disorders: A review and conceptual model. Behaviour Research and Therapy 123, 103501 (2019).
35. Cheng, T. W., Mills, K. L. & Pfeifer, J. H. Revisiting adolescence as a sensitive period for sociocultural processing. Neuroscience & Biobehavioral Reviews 164, 105820 (2024).
36. Kim, P., Xie, Y. & Yang, S. 'I am here for you': How relational conversational AI appeals to adolescents, especially those who are socially and emotionally vulnerable. Preprint at https://doi.org/10.48550/arXiv.2512.15117 (2025).
37. Namvarpour, M. 'Matt', Brofsky, B., Medina, J., Akter, M. & Razi, A. Romance, Relief, and Regret: Teen Narratives of Chatbot Overreliance. Preprint at https://doi.org/10.48550/arXiv.2507.15783 (2025).
38. Neugnot-Cerioli, M. Adolescents & Anthropomorphic AI: Rethinking Design for Wellbeing An Evidence-Informed Synthesis for Youth Wellbeing and Safety. Preprint at https://doi.org/10.48550/arXiv.2603.06960 (2026).

Supporting Literature

- Armitage, K. L., & Gilbert, S. J. (2024). The nature and development of cognitive offloading in children. Child Development Perspectives, 19, 108–115. DOI: 10.1111/cdep.12532
- Bonawitz, E., Shafto, P., Gweon, H., Goodman, N. D., Spelke, E., & Schulz, L. (2011). The double-edged sword of pedagogy: Instruction limits spontaneous exploration and discovery. Cognition, 120(3), 322–330. DOI:10.1016/j.cognition.2010.10.001
- Brosseau-Liard, P., Cassels, T., & Birch, S. A. J. (2014). You seem certain but you were wrong before: Developmental change in preschoolers' relative trust in accurate versus confident speakers. PLOS ONE, 9(9), e108308. DOI: 10.1371/journal.pone.0108308
- Calvert, S. L., Putnam, M. M., Aguiar, N. R., Ryan, R. M., Wright, C. A., Liu, Y. H. A., & Barba, E. (2020). Young children's mathematical learning from intelligent characters. Child Development, 91(5), 1491–1508. DOI: 10.1111/cdev.13341
- Chen, A., Wei, Y., Le, H., & Zhang, Y. (2024). Learning-by-teaching with ChatGPT: The effect of teachable ChatGPT agent on programming education. arXiv:2412.15226. DOI: 10.48550/arXiv.2412.15226
- Chen, A., Xiang, M., Zhou, J., Jia, J., Shang, J., Li, X., Gašević, D., & Fan, Y. (2025). Unpacking help-seeking process through multimodal learning analytics: A comparative study of ChatGPT vs human expert. Computers & Education, 226, Article 105198. DOI: 10.1016/j.compedu.2024.105198
- Goldberg, E., & Magen, H. (2026). Cognitive offloading reduces internal memory processing in children. Scientific Reports. DOI: 10.1038/s41598-026-44574-6
- Goldman, E. J., Baumann, A.-E., Pare, L., Beaudoin, J., & Poulin-Dubois, D. (2025). Children's attribution of mental states to humans and social robots assessed with the Theory of Mind Scale. Scientific Reports, 15, Article 16357. DOI: 10.1038/s41598-025-96229-7
- Goldstein, M. H., Schwade, J. A., & Bornstein, M. H. (2009). The value of vocalizing: Five-month-old infants associate their own noncry vocalizations with responses from caregivers. Child Development, 80(3), 636–644. DOI: 10.1111/j.1467-8624.2009.01287.x
- Henning, A., & Striano, T. (2011). Infant and maternal sensitivity to interpersonal timing. Child Development, 82(3), 916–931. DOI:10.1111/j.1467-8624.2010.01574.x
- Kostka, Genia and Zhou, Hui, Emotional Attachment to AI Chatbots: Evidence from Germany, China, South Africa, and the United States (December 01, 2025). Forthcoming in Technology in Society (2026), Available at SSRN: https://ssrn.com/abstract=5840365 or http://dx.doi.org/10.2139/ssrn.5840365
- Kirkorian, H. L., Pempek, T. A., Murphy, L. A., Schmidt, M. E., & Anderson, D. R. (2009). The impact of background television on parent–child interaction. Child Development, 80(5), 1350–1359. DOI: 10.1111/j.1467-8624.2009.01337.x
- Maeda, T., & Quan-Haase, A. (2024). When Human-AI Interactions Become Parasocial: Agency and Anthropomorphism in Affective Design. Proceedings of the 2024 ACM Conference on Fairness, Accountability, and Transparency.
- Roberts, K. P., Wood, K. R., & Wylie, B. E. (2021). Children's ability to edit their memories when learning about the environment from credible and noncredible websites. Cognitive Research: Principles and Implications, 6, Article 42. DOI: 10.1186/s41235-021-00305-1
- Roseberry, S., Hirsh-Pasek, K., Golinkoff, R. M. (2014). Skype me! Socially contingent interactions help toddlers learn language. Child Development, 85(3), 956–970. DOI: 10.1111/cdev.12166
- Schmidt, M. E., Pempek, T. A., Kirkorian, H. L., Lund, A. F., & Anderson, D. R. (2008). The effects of background television on the toy play behavior of very young children. Child Development, 79(4), 1137–1151. DOI: 10.1111/j.1467-8624.2008.01180.x
- Scofield, J., & Behrend, D. A. (2008). Learning words from reliable and unreliable speakers. Cognitive Development, 23(2), 278–290.
- Yang, F., Oshio, A. (2025). Using attachment theory to conceptualize and measure the experiences in human-AI relationships. Curr Psychol 44, 10658–10669. https://doi.org/10.1007/s12144-025-07917-6
- Xie, T., & Pentina, I. (2022). Attachment Theory as a Framework to Understand Relationships with Social Chatbots: A Case Study of Replika. In Proceedings of the 55th Hawaii International Conference on System Sciences. https://doi.org/10.24251/hicss.2022.258
- Wu X, Liew K, Dorahy MJ (2025). Trust, Anxious Attachment, and Conversational AI Adoption Intentions in Digital Counseling: A Preliminary Cross-Sectional Questionnaire Study. JMIR AI 2025;4:e68960

Glossary

- **Age-band:** A developmentally-meaningful range of ages used to organize the risks and prospects in this report (0–3, 3–6, 6–12, and 12–18 years of age).
- **Anthropomorphism:** The tendency to attribute human-like traits to non-human systems, like large language models.
- **Anthropomorphic design:** The deliberate inclusion or incidental creation of AI system features that make the system appear human-like to users.
- **Attachment:** An essential developmental process of early life involving strong emotional bonds with parents and caregivers.
- **Chatbots:** Conversational AI systems built from large language models that display human-like capacity to engage in spoken and written language.
- **Companion:** A conversational AI system specifically designed to convincingly simulate or role-play as a character to engage with a user, often including persistent personas and emotional or romantic engagement.
- **Cognitive development:** The maturation of thinking and learning abilities across the early lifespan, including attention, memory, language, reasoning, problem-solving, executive function, and metacognition.
- **Co-regulation:** The process by which a parent or caregiver assists a child with regulating emotions, attention, and behavior.
- **Epistemic:** Related to knowledge acquisition, verification, trust, and evaluation.
- **Executive Function:** The set of cognitive and meta-cognitive skills and attributes used to organize behavior around long-term goals, focus attention, hold information in working memory, and inhibit impulses.
- **Fine-tuning:** The set of processes by which an AI model is adjusted after training to alter it's behavior, outputs, or safety.
- **Joint attention:** Developmentally essential shared focus between two individuals, such as a child and a parent.
- **Metacognition:** Representation and awareness of one's own cognitive mental states.
- **Model training:** The process by which an AI system acquires a complex representation of data that constitutes its base of knowledge and action.
- **Scaffolding:** A supportive relation by which a child is helped with practice, skill-building, and the development of autonomy and independence.
- **Social contingency:** The back-and-forth social dynamic essential to the development of spoken and nonverbal communication in childhood.
- **Symbolic play:** The capacity for children to use objects, concepts, or actions to represent other things.
- **Use case:** A specific way a child or adolescent uses AI, such as homework help, search, creative production, entertainment, companionship, emotional support, or communication.