

Exploring Associations Among AI Usage, Anthropomorphism, and Perceived Human Uniqueness in Adolescents

Echo Zexuan Pan (echopan@umich.edu)
University of Michigan, Ann Arbor, MI 48109 USA

Ying Xu (ying_xu@g.harvard.edu)
Harvard University, Cambridge, MA 02138 USA

L. Monique Ward (ward@umich.edu)
University of Michigan, Ann Arbor, MI 48109 USA

Abstract

The growing prevalence of artificial intelligence (AI) prompts reflections on the nature of human identity, particularly regarding perceptions of human uniqueness. Adolescents today interact with AI more frequently than any previous generation, yet little is known about the psychological implications of AI on their development. This study explores the associations among AI usage, anthropomorphism, and perceived human uniqueness in adolescents. Through a survey with 487 adolescents aged 13 to 19, we found 1) older adolescents perceived less agency and experience in humans compared to younger ones, whereas no age-related differences were observed in AI usage, anthropomorphic tendency, and perceptions of AI; 2) higher AI usage and anthropomorphic tendency were associated with reduced perceptions of human uniqueness in both agency and experience; and 3) anthropomorphism could serve as a psychological mechanism linking AI usage and perceived human uniqueness. This study contributes to broader philosophical and societal discussions about AI and human uniqueness.

Keywords: artificial intelligence; adolescents; human uniqueness; anthropomorphism; mind perception

Introduction

Artificial intelligence (AI) has become an integral part of modern society. From AlphaGo's landmark victories against world champions in the strategic game of Go to ChatGPT's ability to simulate human-like conversations, AI systems are demonstrating competencies and characteristics once thought to be unique to humans (Acerbi & Stubbersfield, 2023; Carchidi, 2024; Mei et al., 2024; Orrù et al., 2023). In everyday contexts, AI agents such as Google Assistant and Alexa provide users with personalized support and complement human roles in ways that increasingly blur the boundary between human and machine capacities (Maurya, 2024; Singla et al., 2024; Xu et al., 2024; Zhang et al., 2024).

The growing prevalence of AI prompts reflections on the evolving nature of human identity, particularly regarding perceptions of human uniqueness. This inquiry is highly relevant to younger generations, especially adolescents, who are growing up in a world where AI is as pervasive as smartphones and navigation tools. Adolescence is a critical developmental period characterized by physical, cognitive, and psychological changes that influence identity development and worldview formation (Bernard & Willis, 2024; Cook et al., 2019; Schulenberg & Maslowsky, 2015; Telzer et al., 2022; Tottenham & Galván, 2016). Adolescents today interact with AI more frequently and naturally than any previous

generation. AI-powered tools like virtual assistants, recommendation engines, and chatbots have become embedded in their everyday environment, influencing how they learn, communicate, and create (Huang et al., 2024; Klarin et al., 2024; Woo et al., 2024). According to a national survey by Common Sense Media and Hopelab (2024), over half of adolescents have used generative AI at least once in their lives, with usage patterns ranging from occasional experimentation to daily interaction. The widespread exposure raises questions about how adolescents perceive AI versus humans. As AI agents achieve human-level performance and exhibit human-like characteristics on social cognitive tasks, adolescents may begin to view AI not merely as a tool but as an entity possessing agency and experience akin to humans (Bai et al., 2024; Chuang et al., 2023; Kosinski, 2024; Xu et al., 2024). This perception can be further reinforced by the anthropomorphic design of some AI systems, which are intended to foster a sense of connection or companionship (Li & Suh, 2022; Maeda & Quan-Haase, 2024; Pawlik, 2022).

Investigating adolescents' perceptions of AI versus humans is necessary for several reasons. First, this investigation will provide insights into how adolescents make sense of themselves and the world around them. Adolescence is a formative period during which individuals develop an understanding of identity and relationships (Blakemore & Mills, 2014; Coleman, 2022; Zhang & Qin, 2023). If adolescents consider AI to possess agency and experience, this thought could fundamentally influence their conceptualization of what it means to be human. These perceptions may further shape their expectations of social interactions and their ability to distinguish between authentic human relationships and simulated connections with AI. Second, understanding these perceptions will help design AI systems that are ethical and developmentally appropriate. Adolescents' perceptions of AI may influence their trust and reliance on these technologies (Araujo et al., 2020; Bochniarz et al., 2022; Glikson & Woolley, 2020). By uncovering how adolescents perceive AI versus humans, designers can create AI systems that foster appropriate trust, protect adolescents' well-being, and minimize risks such as over-reliance and social disconnection. Third, studying adolescents' perceptions will contribute to broader philosophical and societal discussions about AI and human uniqueness. Today's adolescents are the first generation to grow up in an AI-infused world,

making their perspectives invaluable for understanding how future societies might navigate the relationship between humans and intelligent machines (Brisson et al., 2023; Lee et al., 2022; Williams, 2022). These insights can inform debates about the role of AI in shaping the human experience, ensuring that technological advancement aligns with ethical values and societal needs.

In this study, we conducted regression and path analyses to explore the associations among AI usage, anthropomorphism, and perceived human uniqueness in adolescents. Three exploratory research questions are asked: 1) Are there any age-related differences in adolescents' AI usage, anthropomorphic tendency, and perceived human uniqueness? 2) How do AI usage and anthropomorphic tendency predict adolescents' perceived human uniqueness? and 3) How might the association between AI usage and perceived human uniqueness, if there is any, be explained by adolescents' anthropomorphic tendency? By answering these questions, this study seeks to provide insights into the developmental patterns of AI experiences and the psychological implications of AI during adolescence.

Method

Participants

This study included 487 adolescents aged 13 to 19 years. Data collection was conducted through Qualtrics as part of a larger project examining adolescents' media consumption and socialization. Ethical approval for this study was obtained from the Institutional Review Board (IRB) at the University, and all procedures adhered to ethical guidelines for research with human participants.

The survey was distributed during October and November 2024. For participants under 18 years of age, parental consent was obtained prior to study. Parents were informed about the study, and those who agreed to participate provided consent on behalf of their child. Adolescents could decline to participate even if their parent provided consent. For participants aged 18 or older, consent was provided directly by the participants themselves. In both cases, the survey was completed anonymously via a secure email link provided by Qualtrics.

The survey was self-administered, taking approximately 20 minutes to complete. Participants received a small monetary compensation through Qualtrics' internal payment system. In addition to the measures analyzed in this study, participants provided demographic information and answered questions about broader media usage. The demographic characteristics of the sample are presented in Table 1.

Measures

AI Usage Adolescents' daily AI usage was assessed using a questionnaire designed to capture interactions with various AI tools commonly used in everyday life. The questionnaire included seven items reflecting typical daily scenarios where adolescents might engage with AI (Wang & Peng, 2023). These scenarios incorporated both traditional AI tools, which

rely on predetermined rules and algorithms to perform specific tasks (e.g., recommendation systems, face recognition software), and generative AI tools, such as applications that transform pictures into drawings or paintings, and conversational agents like ChatGPT. A sample item from the scale is: "How often do you use your face, voice, or fingerprint to unlock a phone, tablet, or computer?" Participants responded using a five-point Likert scale ranging from never to always (never = 1, rarely = 2, sometimes = 3, very often = 4, always = 5). The internal consistency of this scale, as measured by coefficient alpha, was .85, indicating good reliability.

Anthropomorphic Tendency Adolescents' anthropomorphic tendency was assessed using the Individual Differences in Anthropomorphism Questionnaire (IDAQ) developed by Waytz et al. (2010). This measure includes 15 items assessing how much participants attribute human-like mental states and characteristics to non-human entities. A sample item from the scale is: "To what extent does the wind have intentions?" Participants rated each item on a scale from 0 (not at all) to 10 (very much), with higher scores indicating a greater anthropomorphic tendency.

The 15 items in the IDAQ are highly intercorrelated ($\alpha \geq .82$, Waytz et al., 2010), indicating good internal consistency. Additionally, this measure exhibits reasonable test-retest reliability. A study conducted 12 to 19 weeks after the initial assessment reported a significant correlation between the scores across the two time points, $r(67) = .55, p < .001$, providing evidence of its stability over time (Waytz et al., 2010). In the current study, the IDAQ shows excellent internal consistency ($\alpha = .90$), confirming its reliability for assessing anthropomorphic tendency in adolescents.

Table 1: Demographic characteristics of the sample

Description	Statistics
Age	
Mean	16.04
SD	1.79
Median	16
Min	13
Max	19
Gender	n
Cis-girl/Woman	277
Cis-boy/Man	191
Nonbinary/Trans/Gender-queer	19
Ethnicity	n
American Indian/Native American	14
Asian	23
Black/African American	94
Latino or Hispanic	49
Middle Eastern/North African	5
Other	4
White	298

Perceived Human Uniqueness In this study, human uniqueness was operationally defined as the perceived difference between humans and AI in terms of agency and experience. Perceived agency was assessed using two items: “To what extent can a human plan and do things on purpose?” and “To what extent can artificial intelligence (AI) plan and do things on purpose?” Participants rated their perception on a scale from 0 (not at all) to 10 (very much), with separate ratings for humans and AI. Similarly, perceived experience was assessed using two items: “To what extent does a human have the capacity to feel emotions, sensations, and drives?” and “To what extent does artificial intelligence (AI) have the capacity to feel emotions, sensations, and drives?” These items also used a 0-to-10 rating scale.

To compute perceived human uniqueness, the reported value for the AI item was subtracted from the reported value for the human item for each dimension. This computation resulted in two variables: perceived human uniqueness in agency and perceived human uniqueness in experience, representing the extent to which participants viewed humans as distinct from AI in these dimensions.

Results

Descriptive statistics of the main variables and zero-order correlations between the main variables are shown in Table 2 and Table 3.

Age-Related Differences

A series of linear regression analyses were conducted to examine how age predicted adolescents’ AI usage, and anthropomorphic tendency, and perceived human uniqueness. A summary of key findings is presented in Table 4.

There were no age-related differences in anthropomorphism. However, age-related differences were found in perceived human uniqueness in both agency and experience. Older adolescents perceived less distinction between humans and AI in these dimensions. Further analyses revealed that age negatively predicted perceived human agency and experience, suggesting that older adolescents view humans as having less agency and experience compared to younger adolescents. In contrast, no age-related differences were found in the perceived agency or experience of AI, indicating that the attribution of these qualities to AI remains consistent across age groups.

Table 2: Descriptive statistics for main variables

Variable	Mean	SD	Median	Range
AI usage	2.67	0.96	2.71	1–5
Anthropomorphism	3.87	2.21	3.67	0–10
Human agency	8.41	2.23	9.00	0–10
AI agency	4.63	3.50	5.00	0–10
Human experience	8.69	2.30	10.00	0–10
AI experience	2.71	3.21	1.00	0–10

Table 4: Summary of age-related differences in AI usage, anthropomorphism, and perceived human uniqueness

Outcome Variable	Coefficient	P-value
AI usage	-0.01	.564
Anthropomorphism	0.04	.516
Human agency	-0.30	< .001***
AI agency	0.01	.949
Human experience	-0.21	< .001***
AI experience	0.03	.706
Human uniqueness in agency	-0.31	.003**
Human uniqueness in experience	-0.24	.036*

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

The Predicting Role of AI Usage

The summary of regression analyses is presented in Table 5. AI usage was found to be associated with reduced perceptions of human uniqueness in both agency and experience, indicating a narrower perceived distinction between humans and AI. Adolescents with higher AI usage attributed greater agency and experience to AI but did not differ significantly in their perceptions of human agency or experience compared to their peers.

The Predicting Role of Anthropomorphism

Anthropomorphic tendency was associated with reduced perceptions of human uniqueness in both agency and experience, reflecting a smaller perceived distinction between humans and AI. Adolescents with higher anthropomorphic tendencies attributed greater agency and experience to AI than their peers, while attributing less agency and experience to humans than their peers.

Anthropomorphism as a Psychological Mechanism

Path analyses were conducted to examine whether anthropomorphism could serve as a psychological mechanism linking AI usage and perceived human uniqueness. A model with only indirect paths, where AI usage predicts anthropomorphic tendencies, which in turn predict perceived human uniqueness in agency and experience, was tested first. This model demonstrated a good fit to the data, $\chi^2(2) = 0.087$, $p = .957$, CFI = 1.000, TLI = 1.012, RMSEA = 0.000, and SRMR = 0.004.

Next, additional models were tested to determine whether adding direct paths between AI usage and perceived human uniqueness would improve the model fit. Adding a direct path between AI usage and perceived human uniqueness in agency did not improve model fit, $\Delta\chi^2(1) = 0.03$, $p = .864$. Similarly, adding a direct path between AI usage and perceived human uniqueness in experience did not improve model fit, $\Delta\chi^2(1) = 0.02$, $p = .887$. Based on these comparisons, the

Table 3: Zero-order correlations between main variables

	AI usage	Anthropomorphism	Human agency	AI agency	Human experience	AI experience
AI usage	1.00	0.27***	0.05	0.19***	0.04**	0.26***
Anthropomorphism	0.27***	1.00	-0.16**	0.49***	-0.24***	0.67***
Human agency	0.05	-0.16**	1.00	0.05	0.60***	-0.22***
AI agency	0.19***	0.49***	0.05	1.00	-0.04	0.52***
Human experience	0.04**	-0.24***	0.60***	-0.04	1.00	0.54***
AI experience	0.26***	0.67***	-0.22***	0.52***	0.54***	1.00

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

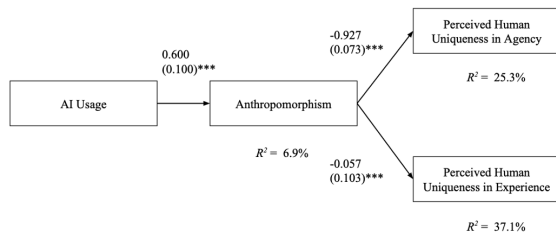
Table 5: Summary of regression analyses for predicting perceived human uniqueness

Outcome Variable	Coefficient	P-value
<i>Predicting Role of AI Usage</i>		
Human agency	0.09	.37
AI agency	0.70	< .001***
Human experience	0.08	.48
AI experience	0.87	< .001***
Human uniqueness in agency	-0.61	.001**
Human uniqueness in experience	-0.79	< .001***
<i>Predicting Role of Anthropomorphic Tendency</i>		
Human agency	-0.15	< .001***
AI agency	0.77	< .001***
Human experience	-0.24	< .001***
AI experience	0.97	< .001***
Human uniqueness in agency	-0.92	< .001***
Human uniqueness in experience	-1.23	< .001***

Note. All models included age as a covariate. *** $p < .001$, ** $p < .01$, * $p < .05$.

original model with only indirect paths was retained as the final model for interpretation.

In the final model, all paths were significant (Figure 1). AI usage was positively associated with anthropomorphic tendencies, indicating that greater AI usage is linked to a stronger tendency to attribute human-like characteristics to non-human entities. Anthropomorphic tendencies were negatively associated with perceived human uniqueness in both agency and experience, reflecting a reduced distinction between humans and AI.



Note. Standard errors are presented in parentheses. *** $p < .001$; ** $p < .01$; * $p < .05$.

Figure 1: Path model

Indirect associations between AI usage and perceived human uniqueness were identified for both agency and experience. These findings suggest that anthropomorphism could serve as a potential psychological mechanism linking AI usage and perceived human uniqueness.

Discussion

Developmental Patterns

No age-related differences were observed in AI usage or anthropomorphic tendency among adolescents in this study. This finding is consistent with Tahiroglu and Taylor's (2019) observation of stable anthropomorphic tendencies in children aged 4 to 6. However, it contrasts with studies showing either a decreasing trend (Airenti, 2018; Li et al., 2017) or an increasing trend (Berry & Springer, 1993; Severson & Lemm, 2016) in anthropomorphism with age. One possible explanation is that the lack of age-related differences reflects developmental stability in anthropomorphic tendencies during adolescence. This relative stability might reflect a plateau in the development of cognitive and social processes directly influencing anthropomorphism (Airenti, 2018; Gao et al., 2024; Gelman et al., 2007). However, another explanation could be

related to the limitations of the measurement tools used in this study. The anthropomorphism measure employed, the IDAQ (Waytz et al., 2010), was originally developed and validated for adult samples. Although it demonstrated good internal consistency with the adolescent sample in this study, its validity in this age group remains uncertain. It is possible that the IDAQ might not fully capture developmental differences in anthropomorphic tendencies among adolescents, leading to the observed lack of age-related differences. To address these issues, two potential directions for future research are recommended. First, age-appropriate measures tailored for adolescents should be developed. Severson and Lemm (2016) emphasized that tools designed for specific developmental stages are better suited to capture nuanced psychological tendencies. Incorporating adolescent-relevant contexts and examples may enhance the sensitivity of anthropomorphism measures. Second, further psychometric validation of the IDAQ with adolescent samples is needed.

Age was negatively associated with perceived human uniqueness in both agency and experience. This pattern was mainly driven by older adolescents perceiving lower human agency and experience compared to younger ones. The first explanation for the observed pattern is related to the impact of stress and socioemotional challenges. Older adolescents face increasing academic, social, and emotional demands (Bandura et al., 2003; Bluth et al., 2017; Romero et al., 2014; Yeager, 2017). These pressures might influence how they view humans, including themselves, as less capable or less emotionally responsive. Research has shown that stress during adolescence can affect self-perceptions and individuals' evaluations of others' abilities (Caldwell et al., 2004; Matsushima & Shiomi, 2003; Piekarska, 2020). The second explanation is related to cognitive and identity development. As adolescents grow older, they develop critical thinking skills and greater awareness of human limitations (Heberle et al., 2020; Kuhn, 1999). This awareness might lead to more skeptical views of human abilities, including agency and experience. Late adolescence is also a time of identity exploration, which can involve questioning societal norms and personal values, possibly contributing to reduced perceptions of human uniqueness (Arnett, 2000; Herry et al., 2024; Sica, 2009; Xie et al., 2021). The third explanation is related to the broader narratives at the societal level. Adolescents are growing up in a society that highlights human incompetencies, such as cognitive biases and inefficiencies (Dunning et al., 2003; Tversky & Kahneman, 1974). These narratives might influence how they perceive humanity. Additionally, as adolescents are increasingly exposed to advanced technologies, their benchmarks for humanness might shift, subtly influencing how they evaluate human capacities in terms of agency and experience (Bandura, 2002; Peters et al., 2024; Verbeek, 2009).

AI Usage, Anthropomorphism, and Perceived Human Uniqueness

AI usage was negatively associated with perceived human uniqueness in agency and experience. This association was

primarily driven by adolescents attributing greater agency and experience to AI. These findings align with research showing that exposure to AI could lead to greater attribution of human characteristics to it (Jacobs et al., 2023). However, the cross-sectional design of this study constrains causal interpretation. It is unclear whether increased AI usage shifts adolescents' perceptions or if adolescents who already perceive AI as possessing agency and experience are more likely to use it. Future research could address this question through randomized controlled trials or longitudinal designs. Using randomized controlled trials, researchers could manipulate the type and frequency of AI usage to examine its effects on adolescents' perceptions of agency and experience. Using longitudinal design, researchers could track changes in perceptions over time and investigate how prolonged interactions with AI influence these perceptions.

This study also found that AI usage was indirectly associated with perceived human uniqueness in agency and experience via anthropomorphism. Adolescents who reported higher AI usage also exhibited stronger anthropomorphic tendencies, which, in turn, were linked to lower perceived human uniqueness. Although the cross-sectional nature of the data prevents causal inferences, this finding suggests a potential pathway worth exploring in future research. Exploring this pathway may uncover both the psychological consequences of AI and the mechanisms underlying these perceptions. This knowledge may further inform how we conceptualize AI within research community.

A tension regarding the ontological status of AI revolves around whether AI should be treated as part of the broader digital technology umbrella or as a more independent entity. If AI is considered as an extension of previous technologies, research may focus on its continuity with past innovations, such as computers or smartphones. In this sense, AI would be studied primarily for its functionality, leaving the psychological implications tied to existing frameworks of human-technology interaction. However, if AI is considered as a new form of existence, a different research approach is required. Studying AI as a new entity would emphasize its potential to influence human cognition, social relationships, and self-perceptions. This perspective calls for research that not only investigates the functionality of AI but also explores how AI would redefine the boundaries between humans and machines. If AI is found to influence psychological outcomes in ways that differ from previous technologies, this finding would provide evidence to support the idea that AI represents a new category of technological and social existence.

Additionally, the findings in this study provide insights into designing AI systems that account for the psychological development of adolescents. Since anthropomorphism was negatively associated with perceived human uniqueness in adolescents, developers are supposed to balance engagement benefits and cognitive risks when implementing anthropomorphic features into AI systems. Ethical design should account for the potential long-term effects of AI systems on

adolescents' cognitive and social development, ensuring that these systems support rather than disrupt adolescents' understanding of humanity.

Implications

For researchers, this study contributes new evidence about adolescents to the anthropomorphism literature. Most studies on anthropomorphism focus on young children or adults, leaving adolescents underexplored. By studying anthropomorphic tendencies in adolescents, this study broadens the age range of anthropomorphism research and provides insights into the developmental trajectories of anthropomorphism. Furthermore, this study adds to the AI literature by examining AI usage as a predictor of psychological outcomes, shifting the focus from studying AI usage as merely an outcome variable.

For educators and parents, this study highlights the need to address why older adolescents report lower levels of perceived human agency and experience. This pattern may be linked to mental health challenges, such as stress or declining self-esteem, which could influence adolescents' self-perceptions and views of humanity. Recognizing and addressing these challenges could inform the design of interventions aimed at supporting adolescents' cognitive and emotional well-being.

Additionally, this study contributes to understanding the psychological implications of AI in adolescents. As AI systems become increasingly integrated into daily lives, adolescents are faced with technologies that may challenge traditional notions of human uniqueness. Preparing adolescents for this challenge requires both developing an understanding of how AI works and fostering their ability to critically think about philosophical questions about human nature, such as what defines intelligence and what distinguishes humans from machines.

References

- Acerbi, A., & Stubbersfield, J. M. (2023). Large language models show human-like content biases in transmission chain experiments. *Proceedings of the National Academy of Sciences*, *120*(44), e2313790120.
- Airenti, G. (2018). The development of anthropomorphism in interaction: Intersubjectivity, imagination, and theory of mind. *Frontiers in Psychology*, *9*, 2136.
- Araujo, T., Helberger, N., Kruikemeier, S., & De Vreese, C. H. (2020). In AI we trust? perceptions about automated decision-making by artificial intelligence. *AI & Society*, *35*(3), 611–623.
- Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, *55*(5), 469–480.
- Bai, X., Wang, A., Sucholutsky, I., & Griffiths, T. L. (2024). Measuring implicit bias in explicitly unbiased large language models (version 2). *arXiv*.
- Bandura, A. (2002). Growing primacy of human agency in adaptation and change in the electronic era. *European Psychologist*, *7*(1), 2–16.
- Bandura, A., Caprara, G. V., Barbaranelli, C., Gerbino, M., & Pastorelli, C. (2003). Role of affective self-regulatory efficacy in diverse spheres of psychosocial functioning. *Child Development*, *74*(3), 769–782.
- Berry, D. S., & Springer, K. (1993). Structure, motion, and preschoolers' perceptions of social causality. *Ecological Psychology*, *5*(4), 273–283.
- Blakemore, S.-J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing? *Annual Review of Psychology*, *65*, 187–207.
- Bluth, K., Campo, R. A., Futch, W. S., & Gaylord, S. A. (2017). Age and gender differences in the associations of self-compassion and emotional well-being in a large adolescent sample. *Journal of Youth and Adolescence*, *46*(4), 840–853.
- Bochniarz, K. T., Czerwiński, S. K., Sawicki, A., & Atroszko, P. A. (2022). Attitudes to AI among high school students: Understanding distrust towards humans will not help us understand distrust towards AI. *Personality and Individual Differences*, *185*, 111299.
- Brisson, J., Bélisle-Pipon, J.-C., & Ravitsky, V. (2023). Investigating the influence of artificial intelligence on adolescent health: An urgent call to action. *Journal of Adolescent Health*, *73*(4), 795.
- Carchidi, V. J. (2024). Do submarines swim? methodological dualism and anthropomorphizing alphago. *AI & Society*, *39*(2), 775–787.
- Chuang, Y.-S., Suresh, S., Harlalka, N., Goyal, A., Hawkins, R., Yang, S., Shah, D., Hu, J., & Rogers, T. T. (2023). The wisdom of partisan crowds: Comparing collective intelligence in humans and llm-based agents (version 2). *arXiv*.
- Common Sense Media & Hopelab. (2024). Teen and young adult perspectives on generative AI: Patterns of use, excitements, and concerns [Retrieved from <https://www.commonensemedia.org/sites/default/files/research/report/teen-and-young-adult-perspectives-on-generative-ai.pdf>].
- Cook, R. E., Nielson, M. G., Martin, C. L., & DeLay, D. (2019). Early adolescent gender development: The differential effects of felt pressure from parents, peers, and the self. *Journal of Youth and Adolescence*, *48*(10), 1912–1923.
- Dunning, D., Johnson, K., Ehrlinger, J., & Kruger, J. (2003). Why people fail to recognize their own incompetence. *Current Directions in Psychological Science*, *12*(3), 83–87.
- Gao, R.-R., Si, S.-W., Lin, X.-X., Wang, Y.-Z., Wang, N., Wang, J.-Y., & Luo, F. (2024). Differential relationships between autistic traits and anthropomorphic tendencies in adults and early adolescents. *Frontiers in Psychology*, *15*, 1281207.
- Gelman, S. A., Heyman, G. D., & Legare, C. H. (2007). Developmental changes in the coherence of essentialist be-

- liefs about psychological characteristics. *Child Development*, 78(3), 757–774.
- Glikson, E., & Woolley, A. W. (2020). Human trust in artificial intelligence: Review of empirical research. *Academy of Management Annals*, 14(2), 627–660.
- Heberle, A. E., Rapa, L. J., & Farago, F. (2020). Critical consciousness in children and adolescents: A systematic review, critical assessment, and recommendations for future research. *Psychological Bulletin*, 146(6), 525–551.
- Herry, E., Rodan, S. M., Martin, M., Sanjak, M. M., & Mulvey, K. L. (2024). White american transgender adults' retrospective reports on the social and contextual aspects of their gender identity development. *British Journal of Developmental Psychology*.
- Huang, S., Lai, X., Ke, L., Li, Y., Wang, H., Zhao, X., Dai, X., & Wang, Y. (2024). AI technology panic—is AI dependence bad for mental health? a cross-lagged panel model and the mediating roles of motivations for AI use among adolescents. *Psychology Research and Behavior Management*, 17, 1087–1102.
- Jacobs, O., Pazhoohi, F., & Kingstone, A. (2023). Brief exposure increases mind perception to chatgpt and is moderated by the individual propensity to anthropomorphize. *arXiv*.
- Klarin, J., Hoff, E., Larsson, A., & Daukantaitė, D. (2024). Adolescents' use and perceived usefulness of generative AI for schoolwork: Exploring their relationships with executive functioning and academic achievement. *Frontiers in Artificial Intelligence*, 7, 1415782.
- Kosinski, M. (2024). Evaluating large language models in theory of mind tasks. *Proceedings of the National Academy of Sciences*, 121(45), e2405460121.
- Li, H., Hsueh, Y., Wang, F., Bai, X., Liu, T., & Zhou, L. (2017). Do young chinese children gain anthropomorphism after exposure to personified touch-screen and board games? *Frontiers in Psychology*, 8.
- Li, M., & Suh, A. (2022). Anthropomorphism in AI-enabled technology: A literature review. *Electronic Markets*, 32(4), 2245–2275.
- Maeda, T., & Quan-Haase, A. (2024). When human-AI interactions become parasocial: Agency and anthropomorphism in affective design. *The 2024 ACM Conference on Fairness, Accountability, and Transparency*, 1068–1077.
- Maurya, R. K. (2024). Using AI-based chatbot chatgpt for practicing counseling skills through role-play. *Journal of Creativity in Mental Health*, 19(4), 513–528.
- Pawlik, V. P. (2022). Design matters! how visual gendered anthropomorphic design cues moderate the determinants of the behavioral intention towards using chatbots. *Chatbot Research and Design*, 13171, 192–208.
- Piekarska, J. (2020). Determinants of perceived stress in adolescence: The role of personality traits, emotional abilities, trait emotional intelligence, self-efficacy, and self-esteem. *Advances in Cognitive Psychology*, 16(4), 309–320.
- Romero, C., Master, A., Paunesku, D., Dweck, C. S., & Gross, J. J. (2014). Academic and emotional functioning in middle school: The role of implicit theories. *Emotion*, 14(2), 227–234.
- Schulenberg, J., & Maslowsky, J. (2015). Contribution of adolescence to the life course: What matters most in the long run? *Research in Human Development*, 12(3–4), 319–326.
- Severson, R. L., & Lemm, K. M. (2016). Kids see human too: Adapting an individual differences measure of anthropomorphism for a child sample. *Journal of Cognition and Development*, 17(1), 122–141.
- Sica, L. S. (2009). Adolescents in different contexts: The exploration of identity through possible selves. *Cognition, Brain, Behavior: An Interdisciplinary Journal*, 13(3), 221–252.
- Tahiroglu, D., & Taylor, M. (2019). Anthropomorphism, social understanding, and imaginary companions. *British Journal of Developmental Psychology*, 37(2), 284–299.
- Telzer, E. H., Dai, J., Capella, J. J., Sobrino, M., & Garrett, S. L. (2022). Challenging stereotypes of teens: Reframing adolescence as a window of opportunity. *American Psychologist*, 77(9), 1067–1081.
- Tottenham, N., & Galván, A. (2016). Stress and the adolescent brain. *Neuroscience & Biobehavioral Reviews*, 70, 217–227.
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases: Biases in judgments reveal some heuristics of thinking under uncertainty. *Science*, 185(4157), 1124–1131.
- Verbeek, P.-P. (2009). Ambient intelligence and persuasive technology: The blurring boundaries between human and technology. *NanoEthics*, 3(3), 231–242.
- Wang, C., & Peng, K. (2023). AI experience predicts identification with humankind. *Behavioral Sciences*, 13(2), 89.
- Woo, D. J., Guo, K., & Salas-Pilco, S. Z. (2024). Writing creative stories with AI: Learning designs for secondary school students. *Innovation in Language Learning and Teaching*, 1–13.
- Zhang, C., Liu, X., Ziska, K., Jeon, S., Yu, C.-L., & Xu, Y. (2024). Mathemyths: Leveraging large language models to teach mathematical language through child-AI co-creative storytelling. *Proceedings of the CHI Conference on Human Factors in Computing Systems*, 1–23.