The Transformation of Communication in a Digital Age

In recent years, the development of new technologies has revolutionized the efficiency and productivity of our world. In fact, 78% of organizations report using artificial intelligence technologies to boost productivity (Stanford University Human-Centered Artificial Intelligence, 2025). Unfortunately, social interactions have suffered as a result, with the amount of time people interact with friends in person decreasing from 30 hours to 10 hours a month. This essay argues that an increased use of technology has had significant biological and psychological impacts on humans, affecting their natural socializing abilities. In addition, this essay proposes that the future of social interaction with technology rests on human intent to preserve in-person engagement and awareness of technology's consequences.

The Evolution of Technology

Motivations for technological advancement have been deeply rooted in humans' natural desire for convenience. Over 2.3 million years ago, human ancestors, the *homo habilis*, were the first to create tools from stones to aid in everyday tasks, such as cutting meat, driven by their survival instincts (Woessner et al., 2021). These convenience-seeking tendencies have fueled numerous technological innovations throughout history, including the steam engine, invented in the 18th century to "release man from reliance on his own or animal muscles or the fickleness of wind and water" (McNeil, 1990, p. 20). However, as technology continued to advance, human perceptions of convenience became less directly tied to survival and necessity. This becomes evident in the shift towards technology as a means of reducing mental workload over physical labor. For example, in the 20th century, the first search engine "Archie" was developed as a method of easily accessing files without sorting through them individually (Seymour et al., 2011, p. 47). Through the years, more advanced software has developed to further increase the efficiency of cognitive work. Most notably, the invention of artificial intelligence (AI) services, such as ChatGPT, has extended beyond simple search engines, interpreting filtered data to provide personalized answers. However, while modern digital services continue to minimize mental labor in our lives, they raise the question of whether a certain level of cognitive challenge is necessary for fundamental human development.

Technology in a Social Context

Indeed, one of the most cognitively demanding yet fundamental behaviors of humans is social interaction. Psychologist Michael Tomasello refers to humans as "the ultra-social animal" due to their remarkable ability to "coordinate…decisions in collaborative situations, especially by communication" (Tomasello, 2014, p. 189). Furthermore, unlike other mammals, humans create phenomena of "social norms, guilt, and shame", in part due to their "need to be accepted by [their] group" (Tomasello, 2014, p. 192). In order to assess appropriate speech in a conversation, humans are required to utilize significant cognitive processing. In fact, the gap between speakers in a daily conversation is approximately 200 milliseconds, in which the next speaker prepares what to say (Heldner and Edlund, 2010). The practice of interpreting observed social cues and converting them into speech almost instantaneously exemplifies advanced social cognition, setting humans' communicative capabilities apart from other species. However, communication skills take time to develop, and in a digital world where efficiency is prioritized over meaningful interpersonal engagement, human social advantages are increasingly diminishing. For example, texting, a form of digital communication often regarded as more convenient, is gradually replacing face-to-face communication. Notably, a significant difference between text communication and in-person communication lies in the reaction time. Text conversations enable the receiver to reply at their own pace, while in-person conversations demand a fast reaction time. By lacking the need to develop the essential quick-thinking skills in face-to-face interactions, individuals are becoming increasingly detached from the nuanced communication crucial for cultivating an empathetic and interconnected community.

Biological Effects of Technology

Adolescents, in their developmental years, are most affected by prolonged exposure to technology, with video games being a particularly popular form of digital entertainment. In recent years, researchers have studied this phenomenon classified as "Internet and Gaming Disorder" (IGD), or the addiction to online gaming. Results show decreased gray matter volume in the anterior cingulate cortex and ventrolateral prefrontal cortex of the brains of adolescents with IGD, correlated with greater impulsivity (Lee et al., 2017). These neurobiological alterations are "[shared]...with other forms of addiction" (Hoehe and Thibaut, 2022). For

example, in a study conducted with eight healthy subjects participating in a video gaming session, results showed a “reduced binding potential…in the ventral striatum, consistent with an increased release and higher binding of dopamine to its receptors”, suggesting that video gaming may cause similar dopamine release patterns to taking “psycho-stimulant drugs such as methylphenidate and amphetamine” (Carpita et al., 2021). Individuals with IGD have been trained to constantly seek the instant gratification that cannot be guaranteed in mundane, everyday social interactions, leading to a decreased motivation for in-person engagement.

More broadly, as our world becomes more digitized, significant trends of physical health deterioration have begun to emerge. According to the World Health Organization, “nearly one third (31%) of the world’s adult population…are physically inactive” (World Health Organization, 2024). This trend worsens in adolescents, with “81% of adolescents (aged 11-17) [being] physically inactive” (World Health Organization, 2024). This large disparity of physical health among age groups shows a strong correlation with each group’s respective technology use. In a study conducted with 3560 United States high school students, researchers surveyed students on their behaviors displaying Problematic Internet Use (PIU), an “uncontrolled use of the internet that leads to significant psychosocial and functional impairments”, and found an overall PIU prevalence of 4%, as compared to the 1.4% to 2.0% PIU prevalence found when adults were surveyed (Liu et al., 2013). With adolescents being the future of our world, their addictive tendencies set the stage for a civilization where uncontrolled technology use becomes the norm, deprioritizing offline activities that play a major role in shaping humans into the complex, social beings they naturally are. Furthermore, research has shown that “significant increases in internet accessibility…have been inextricably linked to associations with enjoyment and fulfillment which the idea of exercise…cannot supersede” (Woessner et al., 2021). As the appeal of exercise deteriorates while the appeal of technology increases, humans are not only at higher risks of obesity and cardiovascular diseases; Sedentary lifestyles are strongly linked to lower self-esteem, blocking the development of social adaptability (Liu et al., 2021).

Conversely, studies have shown exercise as a method of increasing self-esteem, positively influencing social skills. In a study conducted with 1230 college students, surveying them on scales of physical activity and social-emotional competency, physical exercise was

shown to “significantly and positively predict the social adaptability among college students” (Liu et al., 2023). Furthermore, exercise has been proven to be an effective method for adolescents with autism spectrum disorders (ASD) to increase verbal and non-verbal communication skills and motivations for socializing. In a study conducted with 229 children with ASD, when comparing the control group to the children who were supported by a 48-week exercise program, researchers found that “exercise-intervention substantially decreased ASD social interaction problems,...emotional reactivity, [and] stereotypical verbal and motor behavior” (Toscano et al., 2022). Therefore, as digital activities continue to overshadow physical activity, humans not only lack the physical benefits of exercise, but lose the benefits of exercise for developing social motivation and communication skills. While we continue to view exercise as an “inconvenience” in a world characterized by fast-paced technology, we fail to recognize the crucial role it plays in maintaining the core social skills that define our humanity.

Psychological Effects of Technology

Beyond the physical consequences, technology plays a major role in reshaping humans’ perceptions of themselves. During the COVID-19 pandemic, where people all over the world were forced into isolation, communication technologies were viewed as a method of combating the loneliness experienced by many. However, evidence suggests that the use of social media for maintaining interpersonal relationships fell short of face-to-face communication. Dr. Darshana, a psychiatrist from Kaiser Permanente, revealed that during the pandemic, she saw an increasing trend in patients suffering from anxiety, depression, and eating disorders (Dr. Darshana, personal communication, July 2025). Figure 1 shows a spike in depression rates among US adults after the pandemic. While social media enabled people to interact with those they know in real life, it also sparked an increase in interactions with strangers. Dr. Darshana mentioned that a core issue with these stranger interactions is the tendency for strangers to strategically hide information in hopes of presenting the best versions of themselves (Dr. Darshana, personal communication, July 2025). This withholding of information results in low-self esteem for the receiver, who is inclined to compare their multifaceted life with the idealized versions of others’ lives presented digitally. By manipulating the tendencies for humans to compare themselves to others, social media companies gain profits from increased engagement at the expense of users’ mental health. Furthermore, years after the restrictive lockdowns during the pandemic began to lift, Dr.

Darshana reported seeing a continued trend in anxious and depressive tendencies in her patients, discouraging them from partaking in real-world social interactions, although they became accessible again. Evidently, the technological immersion humans were forced into during the pandemic had lasting effects on their motivations and abilities to socialize in person in modern day.

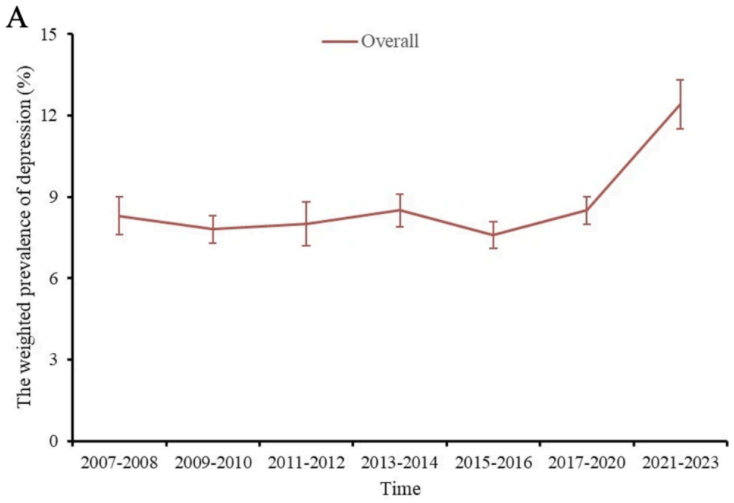

Figure 1: The Weighted Prevalence of Depression Over Time (Jiang et al., 2025)

Although technology has had the ability to facilitate interactions between people online for many years, recent developments have enabled interactions between people and AI, computer systems that mimic the human brain when processing information and responding to queries. As humans repeatedly interact with AI, studies have shown that humans express an unexpected emotional bond and dependency with AI, oftentimes viewing it as a more accurate assessor of their personalities than their own selves. For example, researchers conducted a study with 119 undergraduate students, offering them two agents to recommend products to buy—a “self-agent”, based on personalized suggestions, and an “other-agent”, based on other people’s suggestions (Hamilton et al., 2021). In reality, both agents gave recommendations at random. However, results showed that participants displayed significantly higher levels of purchase intent and more positive brand attitude for the brands recommended by the self-agent. This study highlights the significant dependency and trust humans place in AI; Although both agents gave randomized suggestions, participants blindly trusted the self-agent’s recommendations, likely due to their underlying belief that it understands their personality to a greater extent than they do. This is an

example of “cognitive offloading”, where “individuals delegate cognitive tasks to external aids”, influenced by their natural desire for convenience (Gerlich, 2025). In vesting identities in technology, humans are at an increased risk of personality erosion, where personal beliefs and ideals are being replaced by generalized information and trends perpetuated by AI, even those that may be false. This phenomenon has the risk of reducing authenticity in personal interactions, mimicking the mechanical nature of interactions with AI.

The alarmingly personal relationships humans are developing with AI are further reflected in the increased use of AI companions, or AI that facilitates social conversations with users. Although this idea may appear sound in theory, it has resulted in disastrous consequences. For example, Character.AI, an AI firm that develops AI companions, was sued in 2024 for encouraging teenager Sewell Setzer III suffering from mental health issues to commit suicide (Bakir and McStay, 2025). A major issue with human-AI social interactions lies in the inability to properly express tone, a key factor in human speech. This leads to humans having dangerous ambiguity when interpreting AI messages, and especially in adolescents, who are often highly gullible and impulsive, placing great emphasis on an AI companion’s words could lead to dangerous real-world consequences. When humans and AI companions have such deep, emotional bonds, malfunctions in AI software could have particularly serious consequences, and placing such high levels of trust in a technology so recently developed proves to be highly unsafe.

Navigating Social Interactions in a Digital World

Although technology may be unable to entirely replace in-person interactions, many claim that it is practically useful for daily communication. Indeed, technology can aid in communication when used wisely. For example, Dr. Darshana mentioned that many of her patients struggling with autism tend to be more social when interacting online, even forming virtual communities of their own (Dr. Darshana, personal communication, July 2025). Because interactions online may seem less intimidating for many, particularly due to the lesser emphasis placed on nuanced factors of speech like hand gestures, eye contact, and tone, individuals who struggle with communicating face-to-face, such as those with autism, may find safety in a virtual environment, building their social confidence as a result. In addition, technology can facilitate

communication for those separated by long distances, helping preserve meaningful relationships. However, issues start to emerge when humans abuse technology to avoid in-person conversations altogether, which can greatly deteriorate the interpersonal skills humans are naturally inclined to use. Therefore, it is important to maintain a balance between utilizing the advantages of technology without developing dependency and addiction for it.

A crucial method of fostering social interaction in our digital world is through using technology to support in-person interactions. For example, Dr. Darshana mentioned that in her practice of psychiatry, she often uses an AI scribe to take notes from sessions with her patients (Dr. Darshana, personal communication, July 2025). She revealed that this technology enabled her to spend more time interacting with her patients, as she saved time writing notes manually. By using technology to expedite tasks that impede social interaction with her patients, Dr. Darshana was able to form a deeper personal connection to her patients, aiding in her ability to properly diagnose and treat them. Evidently, when used with the intention of promoting social interaction, technology can be instrumental in fostering an interconnected community. Overall, although technology often has negative behavioral and psychological effects on humans, when used mindfully and in moderation, technology could be a crucial asset to promoting social interactions in our world. Ultimately, the future of meaningful communication in a digital world rests on human discipline and intent.

References

Bakir, V. and McStay, A. (2025). Move fast and break people? Ethics, companion apps, and the case of Character.ai. AI & Society. https://doi.org/10.1007/s00146-025-02408-5

Carpita, B., Muti, D., Nardi, B., Benedetti, F., Cappelli, A., Cremone, I.M., Carmassi, C. and Dell'Osso, L. (2021). Biochemical correlates of video game use: from physiology to pathology. A narrative review. Life, 11(8), 775. https://doi.org/10.3390/life11080775

Gerlich, M. (2025). AI tools in society: impacts on cognitive offloading and the future of critical thinking. Societies, 15(1), 6. https://doi.org/10.3390/soc15010006

Hamilton, K.A., Lee, S.Y., Chung, U.C., Liu, W. and Duff, B.R. (2021). Putting the 'me' in endorsement: understanding and conceptualizing dimensions of self-endorsement using intelligent personal assistants. New Media & Society. https://doi.org/10.1177/1461444820912197

Heldner, M. and Edlund, J. (2010). Pauses, gaps and overlaps in conversations. Journal of Phonetics, 38(4), 555–568. https://doi.org/10.1016/j.wocn.2010.08.002

Hoehe, M. and Thibaut, F. (2022). Going digital: how technology use may influence human brains and behavior. Dialogues in Clinical Neuroscience, 22(2). https://www.tandfonline.com/doi/full/10.31887/DCNS.2020.22.2/mhoehe

Jiang, Y., Deng, W. and Zhao, M. (2025). Influence of the COVID-19 pandemic on the prevalence of depression in U.S. adults: evidence from NHANES. Scientific Reports, 15(1). https://doi.org/10.1038/s41598-025-87593-5

Lee, D., Namkoong, K., Lee, J. and Jung, Y.-C. (2017). Abnormal gray matter volume and impulsivity in young adults with internet gaming disorder. Addiction Biology, 23(5), 1160–1167. https://doi.org/10.1111/adb.12552

Liu, T.C., Desai, R.A., Krishnan-Sarin, S., Cavallo, D.A. and Potenza, M.N. (2013). Problematic internet use and health in adolescents. The Journal of Clinical Psychiatry, 72(6), 836–845. https://doi.org/10.4088/jcp.10m06057

Liu, Y., Liu, H. and Liu, Z. (2021). The relationship of self-presentation, psychological needs, and exercise dependence in college students with overweight. Frontiers in Psychology, 11, 625501. https://doi.org/10.3389/fpsyg.2020.625501

Liu, Y.-F., Feng, Q., Tong, Y. and Guo, K. (2023). Effect of physical exercise on social adaptability of college students: chain intermediary effect of social-emotional competency and self-esteem. Frontiers in Psychology, 14, 1120925. https://doi.org/10.3389/fpsyg.2023.1120925

McNeil, I. (1990). An encyclopedia of the history of technology. London: Routledge.

Pai, D. (2025). Private interview as part of TechFest's STEM Next Essay Competition. Interviewed by AUTHOR, 30 July 2025.

Seymour, T., Frantsvog, D. and Kumar, S. (2011). History of search engines. International Journal of Management & Information Systems (IJMIS), 15(4), 47–58. Available at: https://www.academia.edu/120984923/History_Of_Search_Engines
[Accessed 29 Aug. 2025].

Stanford University (2025). The 2025 AI Index Report. Stanford HAI. Available at: https://hai.stanford.edu/ai-index/2025-ai-index-report
[Accessed 29 Aug. 2025].

Tomasello, M. (2014). The ultra-social animal. European Journal of Social Psychology, 44(3), 187–194. https://doi.org/10.1002/ejsp.2015

Toscano, C.V.A., Ferreira, J.P., Quinaud, R.T., Silva, K.M.N., Carvalho, H.M. and Gaspar, J.M. (2022). Exercise improves the social and behavioral skills of children and adolescents with autism spectrum disorders. Frontiers in Psychiatry, 13, 1027799. https://doi.org/10.3389/fpsyt.2022.1027799

Woessner, M.N., Tacey, A., Levinger-Limor, A., Parker, A.G., Levinger, P. and Levinger, I. (2021). The evolution of technology and physical inactivity: the good, the bad, and the way forward. Frontiers in Public Health, 9, 655491. https://doi.org/10.3389/fpubh.2021.655491

World Health Organization (2024). Physical activity. World Health Organization. Available at: https://www.who.int/news-room/fact-sheets/detail/physical-activity
[Accessed 29 Aug. 2025].