Theory of Mind and Social Anxiety in Emotional Attachment to AI Chatbots in Individuals with Autistic Traits

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Abstract

As conversational AI systems like ChatGPT become increasingly adept at socially engaging interactions, users are more likely to form emotional attachments to these technologies. This study explores the relationship between autistic traits and emotional attachment to ChatGPT, emphasizing the mediating roles of Theory of Mind and social anxiety. A sample of 286 participants completed the study. The structural equation modeling analysis revealed that Theory of Mind partially mediated the relationship between autistic traits and emotional attachment to the chatbot, while social anxiety did not show a significant mediating effect. These findings underscore the critical role of individual differences in shaping attachment to AI, suggesting opportunities for personalized designs and raising questions about the psychological implications of such bonds.

Keywords: autistic traits, theory of mind, social anxiety, AI chatbot, emotional attachment

Introduction

In recent years, conversational artificial intelligence based on neural language models (NLMs) has made human-computer interactions increasingly natural (Fui-Hoon Nah et al., 2023; Suriano et al., 2025). Among the most relevant applications in this field, OpenAI's ChatGPT, launched in 2022, has rapidly gained popularity, attracting millions of users due to its ability to provide immediate and personalized responses, encouraging more frequent and prolonged usage (Choudhury & Shamszare, 2023; Fabio et al., 2024). This intensified interaction may promote the development of emotional attachments to chatbots, creating a cycle of engagement that further motivates users to utilize them (Lei et al., 2021; Skjuve et al., 2022). This phenomenon occurs particularly among users with specific psychological traits (Christoforakos et al., 2021; De Freitas et al., 2023; Lecciso et al., 2021). Among these, autistic traits, distributed along a continuum within the population, are often associated with deficits in ToM, which is the ability to understand and attribute mental states such as intentions, desires, and beliefs to others (Baron-Cohen et al., 2001; Brewer et al., 2017; Gao et al., 2023). This results in reduced social processing, characterized by limited capacity to infer others' emotions and adjust social behavior accordingly (Gillespie-Smith et al., 2018; Thye et al., 2018). Such limitations in socio-cognitive abilities impair the fluency of interpersonal interactions and may contribute to the development of social anxiety. Social anxiety is frequently observed in individuals with high levels of autistic traits and is closely linked to difficulties in social interactions (Lei & Russell, 2021; Schiltz et al., 2021). Research has shown that deficits in ToM and social anxiety are often interconnected; individuals who struggle to understand the intentions and emotions of others are more likely to experience stress and discomfort in social situations (Bemmer et al., 2021; Öztürk et al., 2020). This combination of emotional ToM deficits and social anxiety can lead to reduced interaction with real people, despite the desire to establish relationships (Lei & Ventola, 2018).

In this context, the Theory of Compensatory Internet Use provides a relevant interpretive framework for understanding the adoption of digital technologies in contexts of psychological vulnerability (Ardakan et al., 2021; Fabio et al., 2022; Stanković et al., 2021). According to this theory, individuals with low psychological well-being, often characterized by social or emotional difficulties, use the internet as a tool to compensate for these deficits (Kircaburun et al., 2021; Fabio & Suriano, 2021). Naturally, the social interaction offered by digital technologies has undergone an unprecedented qualitative leap with the introduction of chatbots based on large language models, offering interaction without judgment and without social pressures, helping to reduce anxiety and creating a more comfortable communicative context compared to interactions with other people (Skjuve et al., 2021; Tuna, 2024). The absence of nonverbal communication components, such as facial expressions or body language, simplifies the communicative process (Jung & Park, 2020; Urakami & Seaborn, 2023). This simplification is especially advantageous for those who have difficulty processing such signals, making the interaction more direct and less ambiguous. As a result, uncertainties often present in human conversations are reduced, providing

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a more controlled and predictable environment in which individuals may feel more comfortable and secure (Xygkou et al., 2024). Therefore, it is expected that they will become particularly attractive tools for individuals with autistic traits. A better understanding of how these dynamics influence attachment to AI chatbots is crucial for developing technologies that effectively address the emotional and communicative needs of these individuals, improving the quality of their interactions and their social and psychological well-being (Aghakhani et al., 2023; Holohan & Fiske, 2021; Tosti et al., 2024).

Numerous studies have confirmed that individuals with high levels of social anxiety prefer digitally mediated communication (Elhai et al., 2019; Rozgonjuk et al., 2018). Additionally, interactions with non-human agents are often associated with lower levels of anxiety compared to interactions with other people (Nomura et al., 2008). Individuals with high autistic traits tend to use digital tools to facilitate social interactions, leveraging the predictability and non-judgmental nature of these technologies (Finkenauer et al., 2012; Howard et al., 2021). Chatbots and technological objects, for instance, can serve as substitutes for human interactions, providing relational channels that require less emotional exposure and vulnerability compared to direct interactions with others (Tan et al., 2020).

Most previous studies have focused on different technologies, overlooking the unique characteristics of interactions offered by current neural language models, which have proliferated recently (Hadi et al., 2023; Wang et al., 2024). While earlier technologies, such as the use of the internet or social media, often involve passive activities like browsing or reading without a specific purpose (Frison & Eggermont, 2020), interaction with chatbots represents an interactive and continuous process, involving direct and dynamic conversational exchanges (Skantze, 2021). Additionally, it tends to be a more solitary activity, as it primarily relies on one-on-one interactions rather than group dynamics (Kopp & Krämer, 2021). Few studies, such as that of Hu et al. (2023), have explored how social anxiety can drive the use of conversational AI, examining the complex interaction between variables such as loneliness, rumination, and ToM. However, research involving populations with specific traits, such as those with autistic traits, is lacking, highlighting the need for further investigation into how such traits may influence emotional attachment to chatbots.

The primary objective of the present study is to investigate the relationship between autistic traits and the emotional attachment individuals may develop toward a chatbot powered by a neural language model (NLM). In particular, the study aims to explore how specific cognitive and emotional factors may mediate this relationship. ChatGPT was selected as the chatbot of interest due to its current popularity and widespread recognition among the public, which makes it a familiar and accessible tool for participants. The study focuses on two key mediating variables: ToM (specifically, emotional ToM) and social anxiety. The central hypothesis is articulated in two parts. First, it is expected that individuals with higher levels of autistic traits will tend to exhibit lower emotional ToM abilities and higher levels of social anxiety. Second, it is hypothesized that these two psychological characteristics -namely, reduced emotional ToM and increased social anxiety - will in turn be associated with a stronger emotional attachment to ChatGPT. In other words, emotional connection to the chatbot may be influenced not only by the presence of autistic traits, but also by the individual's ability to understand others' emotions and their comfort or discomfort in social situations.

Methods

Participants

Participants in this study were recruited using a combination of methods. Initially, the questionnaire was distributed via WhatsApp, targeting personal contacts who were encouraged to facilitate further recruitment through word of mouth. Subsequently, the survey form was shared on major social media platforms, including Facebook, Instagram, and Telegram, thereby expanding the geographic reach of the recruitment. To ensure the relevance of the sample, a screening question was included at the beginning of the survey to verify that participants were active users of ChatGPT. Participants were asked to indicate the frequency with which they use the conversational system, and active users were defined as those who use ChatGPT at least once a week. Data collection allowed for the exclusion of ineligible participants, resulting in a final sample of 286 valid participants, including 138 men, 146 women, and 2 individuals identifying as LGBTQIA+. Participants' ages ranged from 18 to 35 years (M = 23.77; SD = 7.34). All participants were of Italian nationality. From a geographic distribution perspective, 60.84% of participants resided in southern regions, 24.12% in northern regions, and the remaining 15.04% in central regions. Regarding employment status, 68.72% were students, 27.57% were employed, and 3.71% were unemployed. In terms of educational level, 27.21% of participants had a bachelor's degree, 20.68% had a master's degree, and 53.21% had a high school diploma or lower.

Procedure

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Prior to participation, participants were provided with a detailed explanation of the research objectives and procedures, along with assurances regarding the protection of their privacy. Participation was voluntary, anonymous, and could be withdrawn at any time. After reading and signing a digital informed consent form, participants were granted access to the questionnaire via a shared link, which redirected them to Google Forms. Google Forms was chosen for its ease of use and compatibility with various devices. To minimize potential order-related biases, the order of the questionnaires was randomized. Upon completing the questionnaires, responses were collected anonymously and automatically stored on the platform.

Measurement

The Autism Spectrum Quotient (AQ; Baron Cohen et al., 2001) is a widely used questionnaire to measure autistic traits in adults (aged 16 and above). It consists of 50 items that assess five different areas: social skills, attention switching, attention to detail, communication, and imagination. Examples of items include: "I prefer to do things with others rather than alone," "I am often so absorbed in something that I lose track of other things," "I tend to notice details that others do not," "I enjoy chatting in company," and "When I read a story, I can easily imagine what the characters might look like." The items are rated on a 4-point Likert scale ranging from 1 (strongly agree) to 4 (strongly disagree). For scoring purposes, responses are dichotomized by assigning 1 point to answers indicative of autistic traits (including some reverse-coded items), resulting in a total score ranging from 0 to 50. A score of 29 or higher is commonly used as a clinical cutoff, although it may not identify all individuals with a formal diagnosis. Higher scores indicate a greater presence of autistic traits. Statistical analyses have shown good reliability and validity of the instrument ($\alpha = 0.83$).

The Reading the Mind in the Eyes Test (RMET; Baron-Cohen et al., 2001), validated in Italy by Vellante et al. (2012), was used to assess the affective component of ToM, specifically the ability to attribute emotional states to others. This tool was chosen for its focus on subtle, non-verbal emotional cues, which are particularly difficult to interpret for individuals with pronounced autistic traits. Despite being a method widely adopted both in clinical practice and for the general population, the indirect measurement of an emotional state is intrinsically critical. Therefore, the validity of RMET has been and continues to be the subject of discussions (Higgins et al., 2024). Nonetheless, it remains one of the most suggested methods (Murphy & Hall, 2024). It consists of 36 photographs depicting only the eye region of male and female models. For each image, participants are asked to select which of the four proposed emotions best represents the expressive feeling of the person, effectively responding to how the depicted person feels. The final score is based on the number of correct responses provided. Statistical analyses demonstrated good internal consistency, with a Cronbach's alpha of $\alpha = .81$.

The Social Interaction Anxiety Scale (SIAS-6; Peters et al., 2012) is a self-report instrument designed to assess social anxiety levels in individuals, focusing on everyday situations involving social interactions, such as one-on-one conversations, group activities, and other forms of socialization. Composed of six items, it includes statements such as "I have difficulty making eye contact with others" and "I feel tense when I am alone with just one person." Responses are provided on a 5-point Likert scale, ranging from 0 (not at all true) to 4 (completely true). Higher scores indicate greater social anxiety, while lower scores reflect minimal anxiety. Internal consistency analysis revealed a Cronbach's alpha of $\alpha = .83$.

The Emotional Attachment Scale (EAS; Thomson et al., 2005) is a tool that measures emotional attachment and brand loyalty. The EAS consists of 12 items and three subscales: affection, connection, and passion. For this study, the term "brand/product" was replaced with "ChatGPT" (e.g., "I feel affection for this brand/product" was modified to "I feel affection for ChatGPT"). The items were rated using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Statistical analyses revealed good internal consistency ($\alpha = 0.89$).

Statistical Analysis

Data analysis was conducted using IBM SPSS Statistics version 28.0 (IBM Corp., Armonk, NY, USA). For each variable, descriptive statistics including the mean (M) and standard deviation (SD) were calculated and reported. Pearson's correlation coefficient was used to examine the relationships among key variables, specifically to explore associations between autism-related traits, ToM, social anxiety, and emotional attachment. Structural equation modeling (SEM) was performed using the IBM SPSS AMOS module to test the mediating roles of ToM and social anxiety in the relationship between autistic traits and emotional attachment to a chatbot. To minimize the risk of Type I errors due to multiple comparisons, a false discovery rate (FDR) correction was applied, with the threshold for statistical significance set at $p < 0.003$.

Results

Means, standard deviations, and ranges for all study variables are presented in Table 1. Participants reported a moderate level of social anxiety ($M = 12.17$, $SD = 5.05$) and emotional ToM ($M = 21.35$, $SD = 5.36$). Emotional attachment to the chatbot AI showed a wide range ($M = 21.73$, $SD = 12.23$), indicating variability in participants' emotional engagement with ChatGPT. Autistic traits were normally distributed in the sample ($M = 20.69$, $SD = 6.13$).

Table 1: Descriptive Statistics for Study Variables

Variable	M	SD	Min	Max
Autistic Traits	20.69	6.13	6	41
Theory of Mind	21.35	5.36	5	33
Social Anxiety	12.17	5.05	6	30
Attachment to AI Chatbot	21.73	12.23	9	70

Note. M = Mean; SD = Standard Deviation; Min = Minimum; Max = Maximum.

Pearson correlation coefficients among the study variables are reported in Table 2. As hypothesized, autistic traits were negatively correlated with emotional ToM ($r = -.293$, $p < .001$), and positively correlated with social anxiety ($r = .527$, $p < .01$). A significant positive correlation was also found between autistic traits and emotional attachment to the chatbot ($r = .176$, $p < .01$). Additionally, ToM was negatively correlated with emotional attachment to the chatbot ($r = -.195$, $p < .01$), while social anxiety did not show a significant correlation with attachment ($r = .027$, ns).

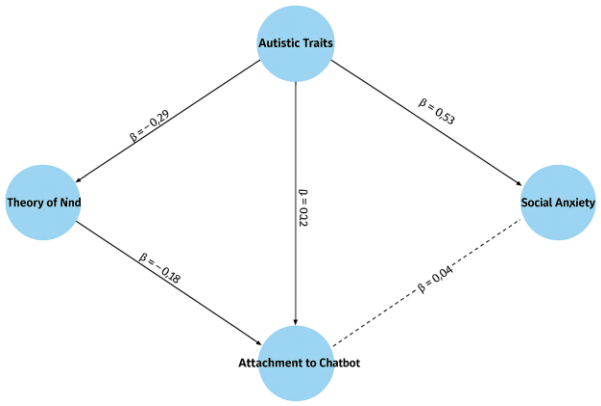
Table 2: Pearson Correlations Between Study Variables

	1.	2.	3.	4.
1. Autistic Traits	-			
2. Theory of Mind	−.293**	-		
3. Social Anxiety	.527**	.047	-	
4. Attachment to AI Chatbot	.176**	−.195**	.027	-

** = p < .001

The mediation model, which examined the roles of ToM and social anxiety as mediators in the relationship between autistic traits and emotional attachment to a chatbot, showed a good fit to the data, $\chi^2(1) = 2.37$, $p = .12$, CFI = .99, TLI = .96, RMSEA = .06 (90% CI [.00, .15]), and SRMR = .021. As hypothesized, autistic traits negatively predicted ToM (β = −.29, $p < .001$) and positively predicted social anxiety (β = .53, $p < .001$). ToM negatively predicted attachment to the chatbot (β = −.18, $p = .004$), while the effect of social anxiety on attachment was nonsignificant (β = .04, $p = .48$). Autistic traits were positively associated with emotional attachment to the chatbot, both directly and indirectly through ToM. Specifically, individuals with higher autistic traits demonstrated significantly lower ToM abilities (β = −.29, $p < .001$). In turn, lower ToM scores predicted higher levels of emotional attachment to the chatbot (β = −.18, $p = .004$). This indirect pathway was statistically significant (β = .052, 95% CI [.014, .095], p = .006), indicating that reduced affective ToM partially mediated the relationship between autistic traits and emotional attachment. No significant indirect effect was found through social anxiety (β = .021, 95% CI [−.018, .059], $p = .31$). These results support the hypothesis that lower emotional ToM partially explains the association between autistic traits and increased emotional attachment to a chatbot. The path diagram presented in Figure 1 shows the relationships between autistic traits, ToM, social anxiety, and emotional attachment to a chatbot

Figure1: Structural equation model examining the relationships between autistic traits, ToM, social anxiety, and emotional attachment to a chatbot. Standardized regression weights (β) are reported on the paths. Dashed lines indicate nonsignificant paths. ToM partially mediated the relationship between autistic traits and attachment.



Discussion

The findings of this study contribute to a deeper understanding of the psychological dynamics that modulate emotional attachment to NLMs-based chatbots like ChatGPT in individuals with autistic traits. In line with existing literature (Baron-Cohen et al., 2001; Brewer et al., 2017; Thye et al., 2018), the data confirm the association between autistic traits, a reduced ToM ability, and elevated levels of social anxiety. However, the analysis using SEM revealed that only ToM significantly mediates the relationship between autistic traits and emotional attachment to the chatbot, while social anxiety does not emerge as a significant mediator. Moreover, the direct effect of autistic traits on emotional attachment remained significant even after accounting for ToM, suggesting that ToM partially mediates this relationship. Therefore, while ToM attenuates the association between autistic traits and attachment, it does not fully eliminate it.

This finding suggests that the ability to understand and attribute mental states and emotions to others – rather than merely social discomfort – is a crucial factor in determining the depth of the emotional bond individuals form with an artificial agent. In other words, a reduced emotional empathy appears to facilitate greater emotional engagement with virtual entities, likely because these interactions require fewer socio-cognitive resources compared to human interactions, making them more accessible, less ambiguous, and more cognitively manageable (Rakap & Balikci, 2024; Xie & Wang, 2024).

In contrast, the fact that social anxiety does not predict or mediate emotional attachment to the chatbot suggests that discomfort in real-world social interactions, as measured by the SIAS-6 (Peters et al., 2012), does not necessarily translate into a stronger emotional bond with chatbots. A possible explanation is that individuals with social anxiety perceive interactions with chatbots as neutral or non-threatening, but do not find them emotionally rewarding. While chatbots may reduce social stress by eliminating the fear of judgment or rejection, this does not automatically lead to the development of emotional attachment. Emotional attachment, as measured by the EAS (Thomson et al., 2005), reflects dimensions of warmth, affection, and involvement – qualities that may not be activated in individuals whose social anxiety leads them to avoid or withdraw from relationships, rather than redirecting their desire for connection toward artificial alternatives. Furthermore, it is plausible that the non-significant effect of social anxiety reflects a conceptual distinction: while social anxiety is an avoidant response driven by the fear of judgment, emotional attachment involves an affective orientation toward approach and connection – two distinct psychological processes, the difference between which may explain the absence of a direct relationship.

These results support the compensatory technology use theory (Ardakan et al., 2021), which suggests that individuals with social and cognitive difficulties may prefer digital tools like ChatGPT to fulfill relational and emotional needs.

However, the central role of ToM suggests that the preference for such technologies is not solely motivated by the avoidance of human interaction, but rather by the search for more predictable, structured, and cognitively less demanding forms of communication.

The analysis of the complex interactions between the examined variables significantly contributes to shaping the overall experience of users with ChatGPT, offering a more complete and nuanced understanding of their impact. The choice of ChatGPT as a reference technology made the research original, considering that it is a relatively recent and widely used tool.

Despite its strengths, the study has some limitations. One limitation concerns the cross-sectional nature of the research design, which prevents the establishment of causal relationships between variables. Longitudinal studies could provide further insights into these relationships over time. Secondly, the sample consists predominantly of young adults from a specific geographic area, limiting the generalizability of the results to other populations, such as older age groups or different cultures. Furthermore, the use of a self-reported sample may have introduced selection bias, such as a preference for individuals with greater familiarity or interest in technology. Additionally, the study focused on a single chatbot (ChatGPT), which may limit the applicability of the results to other AI platforms. ChatGPT has specific features, such as advanced linguistic capabilities and a non-visual interface, which could influence the user experience compared to other chatbots with different functionalities (e.g., those with animated avatars or voice support).

The limitations of this study suggest several directions for future research. Firstly, longitudinal studies could provide a deeper understanding of the causal relationships between psychological traits, anthropomorphism, and emotional attachment. For example, monitoring interactions with chatbots over time could reveal how attachment develops, and which factors influence it the most. Additionally, replicating the study in different cultural contexts and with more heterogeneous samples, including participants of older age or with varying levels of technological familiarity, would be useful. This approach could improve the generalizability of the results and provide insights into potential cultural differences in interacting with chatbots. Another important research direction concerns the analysis of specific chatbot features that promote emotional attachment. Finally, future research could explore the practical implications of the current findings, investigating how chatbots can be designed to better meet the needs of populations with autistic traits or social anxiety.

Conclusion

This study highlights those individuals with autistic traits, through interactions with ChatGPT characterized by simplification and predictability, tend to develop an emotional attachment to this artificial intelligence. These findings help to fill a gap in the literature by exploring the dynamics between specific psychological traits and the use of AI-based technologies. Additionally, they offer new perspectives on the role of conversational AIs in promoting social and psychological well-being, particularly in populations with specific needs. However, further exploration of the long-term implications of these interactions is necessary, balancing potential benefits with possible challenges to ensure that the adoption of these technologies is responsible and inclusive.

References

Aghakhani, S., Carre, N., Mostovoy, K., Shafer, R., Baeza-Hernandez, K., Entenberg, G., ... & Bunge, E. L. (2023). Qualitative analysis of mental health conversational agents messages about autism spectrum disorder: a call for action. *Frontiers in Digital Health*, *5*, 1251016. https://doi.org/10.3389/fdgth.2023.1251016

Ardakan, A. M., Choobforoushzadeh, A., Amini, R., & Shahreza, Z. R. (2021). Relationship Between Personality Traits and Psychological Vulnerability: Mediating Role of Smartphone Social Network Usage. *Iranian Journal of Psychiatry and Behavioral Sciences*, *15*(4). https://doi.org/10.5812/ijpbs.109480

Baron-Cohen, S. (2001). Theory of mind in normal development and autism. *Prisme*, *34*(1), 74-183. https://www.researchgate.net/publication/238603356

Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" Test revised version: a study with normal adults, and adults with Asperger syndrome or high-functioning autism. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *42*(2), 241-251. https://doi.org/10.1017/S0021963001006643

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from asperger syndrome/high-functioning autism, malesand females, scientists and mathematicians. *Journal of autism and developmental disorders*, *31*, 5-17. https://doi.org/10.1023/A:1005653411471

Bemmer, E. R., Boulton, K. A., Thomas, E. E., Larke, B., Lah, S., Hickie, I. B., & Guastella, A. J. (2021). Modified CBT for social anxiety and social functioning in young adults with autism spectrum disorder. *Molecular Autism*, *12*, 1-15. https://doi.org/10.1186/s13229-021-00418-w

Brand, M., Young, K. S., Laier, C., Wölfling, K., & Potenza, M. N. (2016). Integrating psychological and neurobiological considerations regarding the development and maintenance of specific Internet-use disorders: An Interaction of Person-Affect-Cognition-Execution (I-PACE) model. *Neuroscience & Biobehavioral Reviews*, *71*, 252-266. https://doi.org/10.1016/j.neubiorev.2016.08.033

Brewer, N., Young, R. L., & Barnett, E. (2017). Measuring theory of mind in adults with autism spectrum disorder. *Journal of autism and developmental*

disorders, *47*(7), 1927-1941. https://doi.org/10.1007/s10803-017-3080-x

Choudhury, A., & Shamszare, H. (2023). Investigating the impact of user trust on the adoption and use of ChatGPT: survey analysis. *Journal of Medical Internet Research*, *25*, e47184. https://doi.org/10.2196/47184

Christoforakos, L., Feicht, N., Hinkofer, S., Löscher, A., Schlegl, S. F., & Diefenbach, S. (2021). Connect with me. exploring influencing factors in a human-technology relationship based on regular chatbot use. *Frontiers in digital health*, *3*, 689999. https://doi.org/10.3389/fdgth.2021.689999

De Freitas, J., Agarwal, S., Schmitt, B., & Haslam, N. (2023). Psychological factors underlying attitudes toward AI tools. *Nature Human Behaviour*, *7*(11), 1845-1854. https://doi.org/10.1038/s41562-023-01734-2

Elhai, J. D., Levine, J. C., & Hall, B. J. (2019). The relationship between anxiety symptom severity and problematic smartphone use: A review of the literature and conceptual frameworks. *Journal of Anxiety Disorders*, *62*, 45-52. https://doi.org/10.1016/j.janxdis.2018.11.005

Fabio, R. A., Stracuzzi, A., & Lo Faro, R. (2022). Problematic smartphone use leads to behavioral and cognitive self-control deficits. *International journal of environmental research and public health*, 19(12), 7445.

Fabio, R. A., Plebe, A., & Suriano, R. (2024). AI-based chatbot interactions and critical thinking skills: an exploratory study. *Current Psychology*, 1-14. https://doi.org/10.1007/s12144-024-06795-8

Fabio, R. A., & Suriano, R. (2021). The influence of media exposure on anxiety and working memory during lockdown period in Italy. *International Journal of Environmental Research and Public Health*, 18(17), 9279. https://doi.org/10.3390/ijerph18179279

Finkenauer, C., Pollmann, M. M., Begeer, S., & Kerkhof, P. (2012). Brief report: Examining the link between autistic traits and compulsive Internet use in a non-clinical sample. *Journal of autism and developmental disorders*, *42*, 2252-2256. https://doi.org/10.1007/s10803-012-1465-4

Frison, E., & Eggermont, S. (2020). Toward an integrated and differential approach to the relationships between loneliness, different types of Facebook use, and adolescents' depressed mood. *Communication Research*, *47*(5), 701-728. https://doi.org/10.1177/0093650215617506

Fui-Hoon Nah, F., Zheng, R., Cai, J., Siau, K., & Chen, L. (2023). Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration. *Journal of Information Technology Case and Application Research*, *25*(3), 277-304. https://doi.org/10.1080/15228053.2023.2233814

Gao, S., Wang, X., & Su, Y. (2023). Examining whether adults with autism spectrum disorder encounter multiple problems in theory of mind: A study based on meta-analysis. *Psychonomic Bulletin & Review*, *30*(5), 1740-1758. https://doi.org/10.3758/s13423-023-02280-8

Gillespie-Smith, K., Ballantyne, C., Branigan, H. P., Turk, D. J., & Cunningham, S. J. (2018). The I in autism: Severity and social functioning in autism are related to self-processing. *British Journal of Developmental Psychology*, *36*(1), 127-141. https://doi.org/10.1111/bjdp.12219

Hadi, M. U., Qureshi, R., Shah, A., Irfan, M., Zafar, A., Shaikh, M. B., ... & Mirjalili, S. (2023). A survey on large language models: Applications, challenges, limitations, and practical usage. *Authorea Preprints*. https://doi.org/10.36227/techrxiv.23589741.v1

Higgins, W. C., Kaplan, D. M., Deschrijver, E., & Ross, R. M. (2024). Construct validity evidence reporting practices for the Reading the mind in the eyes test: A systematic scoping review. *Clinical Psychology Review*, *108*, 102378.

Holohan, M., & Fiske, A. (2021). "Like I'm talking to a real person": exploring the meaning of transference for the use and design of AI-based applications in psychotherapy. *Frontiers in Psychology*, *12*, 720476. https://doi.org/10.3389/fpsyg.2021.720476

Howard, P. L., & Sedgewick, F. (2021). 'Anything but the phone!': Communication mode preferences in the autism community. *Autism*, *25*(8), 2265-2278. https://doi.org/10.1177/13623613211014995

Hu, B., Mao, Y., & Kim, K. J. (2023). How social anxiety leads to problematic use of conversational AI: the roles of loneliness, rumination, and mind perception. *Computers in Human Behavior*, *145*, 107760. https://doi.org/10.1016/j.chb.2023.107760

Jung, H., Lee, J., & Park, C. (2020). Deriving design principles for educational chatbots from empirical studies on human-chatbot interaction. *J. Digit. Contents Society*, *21*, 487-493. http://dx.doi.org/10.9728/dcs.2020.21.3.487

Kircaburun, K., Balta, S., Emirtekin, E., Tosuntas, Ş. B., Demetrovics, Z., & Griffiths, M. D. (2021). Compensatory usage of the internet: The case of mukbang watching on YouTube. *Psychiatry Investigation*, *18*(4), 269. https://doi.org/10.30773/pi.2019.0340

Kopp, S., & Krämer, N. (2021). Revisiting human-agent communication: The importance of joint co-construction and understanding mental states. *Frontiers in Psychology*, *12*, 580955. https://doi.org/10.3389/fpsyg.2021.580955

Lecciso, F., Levante, A., Fabio, R. A., Caprì, T., Leo, M., Carcagnì, P., ... & Petrocchi, S. (2021). Emotional expression in children with ASD: A pre-study on a two-group pre-post-test design comparing robot-based and computer-based training. Frontiers in psychology, 12, 678052.

Lei, J., & Russell, A. (2021). I have a fear of negative evaluation, get me out of here! Examining latent constructs of social anxiety and autistic traits in neurotypical and autistic young people. *Journal of Autism*

and Developmental Disorders, *51*(5), 1729-1747. https://doi.org/10.1007/s10803-020-04657-3

Lei, J., & Ventola, P. (2018). Characterising the relationship between theory of mind and anxiety in children with Autism Spectrum Disorder and typically developing children. *Research in Autism Spectrum Disorders*, *49*, 1-12. https://doi.org/10.1016/j.rasd.2018.01.005

Lei, S. I., Shen, H., & Ye, S. (2021). A comparison between chatbot and human service: customer perception and reuse intention. *International Journal of Contemporary Hospitality Management*, *33*(11), 3977-3995. https://doi.org/10.1108/IJCHM-12-2020-1399

Murphy, B. A., & Hall, J. A. (2024). How a strong measurement validity review can go astray: A look at and recommendations for future measurement-focused reviews. *Clinical Psychology Review*, *114*, 102506.

Nomura, T., Kanda, T., Suzuki, T., & Kato, K. (2008). Prediction of HUman behavior in human--robot interaction using psychological scales for anxiety and negative attitudes toward robots. *IEEE transactions on robotics*, *24*(2), 442-451. https://doi.org/10.1109/TRO.2007.914004

Öztürk, Y., Özyurt, G., Turan, S., Mutlu, C., Tufan, A. E., & Pekcanlar Akay, A. (2020). Association of theory of mind and empathy abilities in adolescents with social anxiety disorder. *Current Psychology*, 1-10. https://doi.org/10.1007/s12144-020-00707-2

Peñuelas-Calvo, I., Sareen, A., Sevilla-Llewellyn-Jones, J., & Fernández-Berrocal, P. (2019). The "Reading the Mind in the Eyes" test in autism-spectrum disorders comparison with healthy controls: a systematic review and meta-analysis. *Journal of autism and developmental disorders*, *49*, 1048-1061. https://doi.org/10.1007/s10803-018-3814-4

Peters, L., Sunderland, M., Andrews, G., Rapee, R. M., & Mattick, R. P. (2012). Development of a short form Social Interaction Anxiety (SIAS) and Social Phobia Scale (SPS) using nonparametric item response theory: the SIAS-6 and the SPS-6. *Psychological assessment*, *24*(1), 66. https://psycnet.apa.org/doi/10.1037/a0024544

Rakap, S., & Balikci, S. (2024). Enhancing IEP goal development for preschoolers with autism: A preliminary study on ChatGPT integration. *Journal of Autism and Developmental Disorders*, 1-6.

Rozgonjuk, D., Levine, J. C., Hall, B. J., & Elhai, J. D. (2018). The association between problematic smartphone use, depression and anxiety symptom severity, and objectively measured smartphone use over one week. *Computers in Human Behavior*, *87*, 10-17. https://doi.org/10.1016/j.chb.2018.05.019

Schiltz, H. K., McVey, A. J., Dolan Wozniak, B., Haendel, A. D., Stanley, R., Arias, A., ... & Van Hecke, A. V. (2021). The role of loneliness as a mediator between autism features and mental health among autistic young adults. *Autism*, *25*(2), 545-555. https://doi.org/10.1177/1362361320967789

Skantze, G. (2021, March). Conversational Interaction with Social Robots. In *Companion of the 2021 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 717-717). https://doi.org/10.1145/3434074.3444877

Skjuve, M., Følstad, A., Fostervold, K. I., & Brandtzaeg, P. B. (2022). A longitudinal study of human–chatbot relationships. *International Journal of Human-Computer Studies*, *168*, 102903. https://doi.org/10.1016/j.ijhcs.2022.102903

Skjuve, M., Følstad, A., Fostervold, K. I., & Brandtzaeg, P. B. (2021). My chatbot companion-a study of human-chatbot relationships. International Journal of Human-Computer Studies, 149, 102601. https://doi.org/10.1016/j.ijhcs.2021.102601

Stanković, M., Nešić, M., Čičević, S., & Shi, Z. (2021). Association of smartphone use with depression, anxiety, stress, sleep quality, and internet addiction. Empirical evidence from a smartphone application. *Personality and individual differences*, *168*, 110342. https://doi.org/10.1016/j.paid.2020.110342

Suriano, R., Plebe, A., Acciai, A., & Fabio, R. A. (2025). Student interaction with ChatGPT can promote complex critical thinking skills. *Learning and Instruction*, *95*, 102011. https://doi.org/10.1016/j.learninstruc.2024.102011

Tan, H., Zhao, Y., Li, S., Wang, W., Zhu, M., Hong, J., & Yuan, X. (2020). Relationship between social robot proactive behavior and the human perception of anthropomorphic attributes. *Advanced Robotics*, *34*(20), 1324-1336. https://doi.org/10.1080/01691864.2020.1831699

Thomson, M., MacInnis, D. J., & Whan Park, C. (2005). The ties that bind: Measuring the strength of consumers' emotional attachments to brands. *Journal of consumer psychology*, *15*(1), 77-91. https://doi.org/10.1207/s15327663jcp1501_10

Thye, M. D., Bednarz, H. M., Herringshaw, A. J., Sartin, E. B., & Kana, R. K. (2018). The impact of atypical sensory processing on social impairments in autism spectrum disorder. *Developmental cognitive neuroscience*, *29*, 151-167. https://doi.org/10.1016/j.dcn.2017.04.010

Tosti, B., Corrado, S., & Mancone, S. (2024). Using Chatbots and Conversational Agents for the Promotion of Well-being and Mental Health in Adolescents: Limitations and Perspectives. *Journal of Inclusive Methodology and Technology in Learning and Teaching*, *4*(1). https://doi.org/10.32043/jimtlt.v4i1.128

Tuna, A. (2024). Use of Chatbots to Support the Inclusion of People With Autism Spectrum Disorder. In *Integrating Generative AI in Education to Achieve Sustainable Development Goals* (pp. 434-448). IGI Global. http://dx.doi.org/10.4018/979-8-3693-2440-0.ch024

Urakami, J., & Seaborn, K. (2023). Nonverbal cues in human–robot interaction: A communication studies perspective. *ACM Transactions on Human-Robot Interaction*, *12*(2), 1-21. https://doi.org/10.1145/3570169

Vellante, M., Baron-Cohen, S., Melis, M., Marrone, M., Petretto, D. R., Masala, C., & Preti, A. (2012). The "Reading the Mind in the Eyes" test: Systematic review of psychometric properties and a validation study in Italy. *Cognitive Neuropsychiatry*, *18*(4), 326–354. https://doi.org/10.1080/13546805.2012.721728

Wang, Z., Chu, Z., Doan, T. V., Ni, S., Yang, M., & Zhang, W. (2024). History, development, and principles of large language models: an introductory survey. *AI and Ethics*, 1-17. https://doi.org/10.1007/s43681-024-00583-7

Xie, Z., & Wang, Z. (2024). Longitudinal Examination of the Relationship Between Virtual Companionship and Social Anxiety: Emotional Expression as a Mediator and Mindfulness as a Moderator. *Psychology Research and Behavior Management*, 765-782. https://doi.org/10.2147/PRBM.S447487

Xygkou, A., Siriaraya, P., She, W. J., Covaci, A., & Ang, C. S. (2024). "Can I be More Social with a Chatbot?": Social Connectedness Through Interactions of Autistic Adults with a Conversational Virtual Human. *International Journal of Human–Computer Interaction*, 1-18. https://doi.org/10.1080/10447318.2023.2292880