

**WHEN AI FEELS LIKE A HUMAN:
ANTHROPOMORPHISATION, LONELINESS, AND PROBLEMATIC USE OF
CHATBOTS AMONG SCHOOL TEACHERS IN POLAND**

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Abstract: *The rapid spread of AI chatbots has raised concerns about problematic patterns of use resembling behavioral addictions. This study examined the relationship between problematic AI use, loneliness, and anthropomorphization. Based on a sample of 102 Polish adult AI chatbot users working as school teachers who completed a survey, we found that higher loneliness was associated with stronger anthropomorphization and greater problematic AI use, although the effects were modest. However, the data did not support the mediating role of anthropomorphization. Overall levels of anthropomorphization and social motivation were low, suggesting that these factors may play a limited role in groups that use AI mainly for practical, work-related purposes. Qualitative aspects of engagement may be more informative than time-based indicators alone, highlighting the need to go beyond purely quantitative measures of AI use when assessing problematic engagement.*

Keywords: *loneliness, anthropomorphization, artificial intelligence, problematic AI use, behavioral addiction, AI addiction*

INTRODUCTION

Artificial intelligence is increasingly becoming an integral part of the everyday functioning of individuals and institutions. A particularly important role in this process is played by so-called conversational agents—systems designed to enable natural language interaction with users. These systems may be used both for casual, informal exchanges and for providing information relevant to completing specific tasks (Wahde & Virgolin, 2022). Some of them take the form of chatbots based on large language models (LLMs), which are trained on large-scale text datasets to understand and generate natural language (Naveed et al., 2023), such as ChatGPT, Gemini, and Copilot.

In recent years, these technologies have spread rapidly. In July 2025, approximately 700 million users—nearly 10% of the world's adult population—sent a total of 18 billion messages per week to ChatGPT alone (Chatterji et al., 2025). Given their broad range of applications, interactions with AI chatbots may involve everyday activities such as information seeking or obtaining practical advice, and may occur in both personal and professional contexts. They may also serve different psychological and practical roles, for example, of a mentor, an indispensable tool, or a conversational partner supporting mood regulation (Li & Zhang, 2025).

Alongside this expansion, chatbot technologies have diversified considerably. They range from general-purpose AI chatbots based on LLMs, such as ChatGPT and Gemini, to more specialized systems designed for companionship (e.g., Replika), mental health support (e.g., Wysa), or workplace productivity enhancement (e.g., Copilot).

AI Usage as a Behavioral Addiction

With the growing popularity of AI chatbots, discussions have emerged regarding their potential negative consequences for both individuals and society. Although the use of AI may also have beneficial effects for users (Heinz et al., 2025; Sağlam & Kalanlar, 2025), researchers have suggested that intensive chatbot use may share certain characteristics with behavioral addictions (Al-Obaydi & Pikhart, 2026; Kooli, Kooli, & Kooli, 2025; Li & Zhang, 2025).

Among the potentially addictive features of AI chatbots, researchers have identified, e.g., personalized feedback and productivity boost (Yankouskaya, Liebherr, & Ali, 2025), as well as non-deterministic responses, notifications, and the immediate visual presentation of responses (Shen & Yoon, 2025). Use of AI dialogue systems may foster over-reliance on these tools in decision-making contexts (Zhai, Wibowo, & Li, 2024) or, potentially, cognitive atrophy (Sætra, 2023). At the same time, the intensity of these interactions may also be related to their relational dimension, as they can take on characteristics of parasocial relationships (Yankouskaya et al., 2025), become long-term, and in some respects resemble human interpersonal bonds (Skjuve, Følstad, Fostervold, & Brandtzaeg, 2022).

However, the clinical status of “AI addiction” remains insufficiently established in the view of some researchers. For example, Ciudad-Fernández, Von Hammerstein and Billieux (2025) argue that studies in this area rely too heavily on instruments adapted from measures originally developed for other behavioral addictions (e.g., gaming disorder). As they note, there is still limited empirical

evidence regarding the extent to which the characteristics of intensive AI use actually overlap with those of recognized behavioral addictions. In particular, neurobiological and physiological evidence remains lacking (Ciudad-Fernández et al., 2025). Furthermore, longitudinal research has shown that although mental health difficulties predict subsequent AI dependence, the latter does not predict later anxiety or depression symptoms (Huang et al., 2024).

Loneliness and Anthropomorphization as a Potential Pathway to Problematic AI Use

Accordingly, due to their versatility and diversity, AI systems may fulfill a wide range of functions. This is reflected in the variety of motives reported for AI use, including instrumental, hedonic, relational, and escapist motives (Huang et al., 2024). It therefore appears crucial to identify the specific pathways through which interactions with AI chatbots may contribute to problematic or addictive patterns of use (Al-Obaydi & Pikhart, 2026).

Although productivity enhancement and task automation may represent important risk factors, potential pathways to problematic AI use should not be reduced solely to the tool-like functions of these systems. Among the pathways discussed in the literature are relational aspects of AI use, whereby users may come to perceive AI as a partner or mentor (Li & Zhang, 2025), someone akin to a friend (Skjuve et al., 2022), or even a romantic partner (Ma & Koike, 2025). Such perceptions suggest that one potentially important pathway may involve the anthropomorphization of AI—

that is, attributing human-like qualities to non-human systems.

Anthropomorphization, that is, the human tendency to attribute human-like mental states to non-human entities, refers to perceiving such entities as possessing thoughts, emotions, or intentions (Epley & Waytz, 2010). The fact that chatbots increasingly communicate fluently, respond contextually, and adapt their outputs in ways that resemble human conversational styles suggests that they may be particularly likely targets of anthropomorphization (Yankouskaya et al., 2025; (Zimmerman, Janhonen, & Beer, 2024)).

Indeed, even before the rise of contemporary AI technologies, Nass and Moon (2000) demonstrated that people tended to apply social scripts typically reserved for human relationships when interacting with computers (e.g., showing politeness). More recently, Waytz et al. (2014) showed that such tendencies also extend to autonomous vehicles, with anthropomorphization increasing trust in self-driving cars. Pentina et al. (2023) further argued that anthropomorphization of Replika may, in some cases, extend beyond automatic or “mindless” social responses and involve perceptions of the chatbot’s cognitive capacities. In the qualitative component of their study, some users described Replika as creative, caring, and, to some extent, authentic (Pentina et al., 2023). Similarly, in the study by Skjuve et al. (2022), some participants perceived their relationship with Replika from the outset as partly friendship-like and extending beyond purely instrumental use.

Anthropomorphization may foster dependence on and attachment to AI systems (Al-Obaydi & Pikhart, 2026; Kooli et al., 2025), be associated with the quality of social interactions with AI (Pentina et al.,

2023), and strengthen the link between parasocial relationships and intentions to use AI (Peng et al., 2025). It may also enable users to receive emotional validation and a sense of companionship from chatbots with relatively little effort on the user's part (Yankouskaya et al., 2025).

One factor that may promote anthropomorphism is loneliness. Epley et al. (2008) showed that a lack of social connection and feelings of loneliness are associated with a greater tendency to anthropomorphize non-human entities. Similar findings were later reported by Wang (2017) regarding smartphones. More recently, Feng and Dang (2025) showed that the association between loneliness and robot anthropomorphism may depend on social motivational pathways and cultural context, with positive effects being more pronounced in Western samples. In the context of human–chatbot relationships, Skjuve et al. (2022) reported that some users began using Replika because they felt lonely or wanted someone to talk to.

In the present study, we sought to examine the relationships among loneliness, AI anthropomorphization, and problematic AI use. Our first hypothesis concerned the association between loneliness and the anthropomorphization of AI systems. Given the established link between anxiety and depressive symptoms and AI dependence (Huang et al., 2024; Zhang, Li, Yin, et al., 2025; Zhang, Li, Zhang, et al., 2025), levels of anxiety and depressive symptoms were included in the analyses in order to isolate the specific role of loneliness. We hypothesized that loneliness will be positively associated with the level of AI chatbot anthropomorphization after controlling for anxiety and depressive symptoms.

The second hypothesis concerned the relationship between loneliness and

problematic AI use via AI system anthropomorphization. Prior research indicates that social motivation is associated with greater dependence on AI chatbots (Huang et al., 2024), while loneliness has been linked to symptoms resembling addictive patterns of use (Marriott & Pitardi, 2024). Given the previously discussed association between loneliness and anthropomorphism, as well as evidence that anthropomorphism may intensify engagement with AI, we hypothesized that loneliness would be positively associated with problematic AI use indirectly through greater anthropomorphism of AI chatbots. We expected this relationship to remain significant after controlling for anxiety and depressive symptoms.

In addition to problematic AI use, we also included quantitative indicators of use, namely the number of days of AI use per week and the average daily duration of interaction. Research on gaming disorder suggests that the amount of time spent on a given activity does not necessarily indicate its dysfunctional nature (Király et al., 2023; Billieux et al., 2019). For this reason, associations between time spent using AI and the other study variables were treated as exploratory. We were interested in whether there is a relationship between loneliness and anthropomorphization, and quantitative indicators of AI use (number of days per week and average daily interaction time).

Furthermore, given the mixed findings regarding the relationship between intensity of use and problematic use, we explored the relationship between the amount of time spent using AI and the severity of problematic AI use.

METHODS

Participants

The participants were primary and secondary school teachers from the Bielany district of Warsaw who took part in the project “Bielany promotes prevention, counters addiction, and supports diversity”. The project was co-funded by the Bielany District Office of the City of Warsaw and Research Development Center Ltd. (Centrum Rozwoju Badań Sp. z o.o.), and was implemented within the municipal framework for prevention and health promotion.

The initiative included a range of educational and informational activities focused on addiction prevention, strengthening emotional competencies, and addressing the increased risk of addiction among neurodivergent individuals. An important component of the program was the integration of scientific knowledge with lived experience through lectures and workshops delivered, among others, through the expert-by-experience model. This included the participation of a lecturer who was autistic, had ADHD, and had personal experience with addiction.

A total of 136 individuals provided informed consent and participated in the study. Of these, 102 participants who reported using AI chatbots were included in the present analyses. The sample consisted of 80 women, 20 men, and 2 individuals who selected “prefer not to say” for gender. The largest age group was 35–44 years (36.3%), followed by 45–54 years (31.4%), 25–34 years (17.6%), and 55 years or older (13.7%); 1.0% were aged 18–24 years. All participants had completed higher education.

Procedure

Participants enrolled in the project “Bielany promotes prevention, counters addiction, and supports diversity” first attended 90-minute educational sessions on addiction in the context of neurodiversity. Following the sessions, participants were invited to complete an online survey. They were informed about the aims of the study, the voluntary nature of participation, and their right to withdraw at any stage without providing a reason. All data were collected anonymously. Data collection took place in November and December 2025.

Measures

Anthropomorphization was assessed based on mind perception theory (Gray, Gray, & Wegner, 2007). An original six-item scale was developed by selecting indicators reflecting the two core dimensions of mind perception: experience and agency. Participants rated the extent to which AI systems possess the following characteristics: emotions, consciousness, personality, memory, action planning, and independent thinking. Responses were given on a 5-point scale. The full wording of items is provided in Appendix 1.

Problematic AI use was measured using a brief three-item symptom index based on criteria for behavioral addictions included in the ICD-11. The items referred to disruption of life balance due to AI use, spending more time using AI than intended, and continuing to use AI despite negative consequences. This was not intended as a diagnostic instrument; rather, its purpose was to capture the general severity of distinct but related symptoms corresponding to behavioral addiction criteria. Responses were given on a 5-point scale (provided in Appendix 2).

Loneliness was measured using the short three-item version of the UCLA Loneliness Scale (UCLA-3; Hughes et al., 2004), translated by the authors. Responses were given using the standard frequency scale. The measure is available in Appendix 3.

To distinguish the effects of loneliness from broader psychological distress, an additional control measure was included. Symptoms of anxiety and depression were assessed using the PHQ-4 (Kroenke, Spitzer, Williams, & Lowe, 2009) in the Polish adaptation validated by Larionow and Mudło-Głagolska (2023).

Two behavioral indicators of AI use intensity were included: the number of days of AI use per week and the average daily duration of use expressed in minutes.

To characterize the sample, four single-item measures assessing motives for AI chatbot use were used: instrumental, hedonic, relational, and escapist motives. These items were rated on a 5-point Likert scale and were based on Huang et al. (2024). The full wording is presented in Appendix 4.

RESULTS

The AI anthropomorphization scale demonstrated excellent internal consistency ($\alpha = .939$). Item-total correlations were high, ranging from .797 to .890, indicating strong coherence among items and substantial associations with the overall score. Exploratory factor analysis supported a unidimensional structure for the scale: all items loaded strongly on a single factor (loadings ranged from .87 to .96), accounting for 82.4% of the variance. Accordingly, anthropomorphization was treated as a single composite indicator in subsequent analyses (as in Waytz et al., 2014).

The main study variables were assessed using self-report questionnaires with established psychometric properties and author-developed scales. Psychometric properties of the measures are reported in the Results section. Although the study formed part of a broader project, the present article focuses only on variables relevant to the tested model.

Data analysis

Statistical analyses were conducted using JASP (Version 0.95.4.0). In the first step, descriptive statistics as well as skewness and kurtosis coefficients were calculated for all study variables. Based on these distributional indicators, associations between variables were examined using Pearson's product-moment correlation coefficients.

A mediation analysis was then performed using maximum likelihood estimation. Bootstrap procedures with 5,000 resamples were applied to estimate confidence intervals for the indirect effects.

The UCLA-3 loneliness scale showed acceptable internal consistency ($\alpha = .741$), comparable to the reliability reported for the original version ($\alpha = .72$; Hughes et al., 2004). Item-total correlations were moderate, ranging from .566 to .576. Exploratory factor analysis also supported a single-factor structure, with all items loading on a single factor (loadings ranging from .69 to .71), accounting for 49.4% of the variance.

The three-item problematic AI use index, based on ICD-11 criteria, demonstrated moderate internal consistency ($\alpha = .685$). Item-total correlations ranged from .505 to .569. Because the items were designed to reflect

distinct diagnostic criteria (priority given to AI use, loss of control, and continuation despite negative consequences), the measure was treated as an indicator of symptom severity rather than as a homogeneous scale. Although these criteria are conceptually linked within the broader category of behavioral addiction, they were not assumed to represent a single latent construct. Therefore, the observed reliability was considered acceptable for the present exploratory purposes, and the scale was analyzed as a summed index of problematic use severity.

The PHQ-4 demonstrated good internal consistency ($\alpha = .846$). In the validation study by Larionow and Mudło-Głagolska (2023), omega coefficients of at least .70 were reported for the total score and subscales. Item–total correlations in the present sample were satisfactory, ranging from .645 to .740. Exploratory factor analysis in the present sample suggested a strong general factor, with all items loading from .71 to .83 and explaining 58.6% of the variance. In the validation study, a one-factor model showed acceptable fit,

whereas the theoretically intended two-factor model (anxiety and depression) demonstrated excellent fit.

At the preliminary stage, variable distributions were examined using skewness and kurtosis coefficients. Although some variables showed moderate positive skewness, all values fell within ranges commonly considered acceptable for parametric analyses (skewness < 2 ; kurtosis < 7 ; Kim, 2013). Given the sample size, this supported the use of maximum likelihood estimation in the mediation analysis and of Pearson's correlation coefficients.

Age and gender were not significantly associated with the main study variables (loneliness, anthropomorphization, or problematic AI use; all $p > .05$) and were therefore not included as control variables in subsequent analyses.

As shown in Table 1, instrumental motivation had the highest mean score, followed by entertainment and escape motivation. Social motivation was the least frequently reported motive for using AI chatbots.

Table 1. Means and Standard Deviations of Motives for AI Chatbot Use.

	instrumental motivation	social motivation	escape motivation	entertainment motivation
M	3.549	1.196	1.314	1.569
SD	1.295	0.614	0.820	1.000

Note. Scale range 1–5.

As shown in Table 2, loneliness was positively correlated with anthropomorphism and problematic AI use. Anthropomorphism was also positively associated with problematic use. Among behavioral indicators, only the average daily time spent using AI, but not the

number of days of use, was significantly related to problematic use.

Table 2. Descriptive Statistics and Correlations Among the Study Variables

Variable	Scale range	M	SD	1	2	3	4	5	6
1. Loneliness	1-3	1.281	0.403	—					
2. Anthropomorphism	1-5	1.985	1.032	.362***	—				
3. Problematic use	1-5	1.389	0.578	.310**	.295**	—			
4. Anxiety and depressive symptoms	0-3	0.917	0.726	.569***	.265**	.243*	—		
5. Average daily time spent using AI	-	15	10.32	.083	.058	.252*	.054	—	
6. Number of days per week using AI	-	2.51	1.745	.052	.111	.116	.219*	.387***	—

Note. $p < .05^*$, $p < .01^{**}$, $p < .001^{***}$. Mean scores for the psychological scales were calculated as the average of responses to the individual items.

Regarding our first hypothesis, the results revealed a significant positive association between loneliness and AI chatbot anthropomorphization, $r = .27$, $p = .007$, independent of anxiety and depressive symptoms. Anxiety and depressive symptoms were not significantly associated with anthropomorphization after controlling for loneliness, $r = .08$, $p = .441$.

Regarding our second hypothesis, anthropomorphization was positively

associated with problematic AI use after controlling for loneliness, and loneliness was positively associated with anthropomorphization, which provided justification for conducting a mediation analysis (see Figure 1).

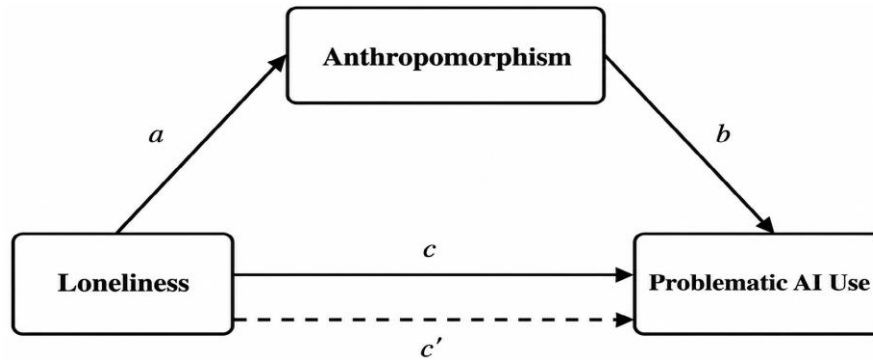


Figure 1. Mediation model testing anthropomorphism as a mediator of the association between loneliness and problematic AI use. *a* = path from loneliness to anthropomorphism; *b* = path from anthropomorphism to problematic AI use; *c* = total effect; *c'* = direct effect.

To test the mediation hypothesis, a mediation analysis was conducted using maximum likelihood (ML) estimation and bootstrapping (5,000 resamples, 95% CI), while controlling for anxiety and depressive symptoms (PHQ-4). The total effect of loneliness on problematic AI chatbot use was significant ($\beta = .254$, $SE = .124$, $z = 2.051$, $p = .040$). However, the direct effect, after accounting for the mediator, did not reach statistical significance ($\beta = .190$, $SE = .134$, $z = 1.422$, $p = .155$).

The path from loneliness to anthropomorphization was significant ($\beta =$

$.312$, $SE = .120$, $z = 2.599$, $p = .009$), whereas the path from anthropomorphization to problematic AI use was not ($\beta = .205$, $SE = .123$, $z = 1.671$, $p = .095$). The indirect effect was not significant ($\beta = .064$, $SE = .052$, 95% CI $[-.004, .207]$), as the confidence interval included zero. This indicates that anthropomorphization did not serve as a significant mediator in the relationship between loneliness and problematic AI chatbot use. The model explained 13.1% of the variance in problematic AI use ($R^2 = .131$).

Table 3. The Mediating Effect of Anthropomorphism on the Relationship between Loneliness and Problematic Use.

		<i>SE</i>	<i>Beta</i>	<i>p</i>	<i>LL</i>	<i>UL</i>
a	The effect of loneliness on anthropomorphism	0.120	0.312	.009	0.072	0.545
b	The effect of anthropomorphism on problematic use	0.123	0.205	.095	-0.042,	0.442
c	The effect of loneliness on problematic use	0.124	0.254	.040	-0.008	0.480
c'	The direct effect of loneliness on problematic use	0.190	0.134	.155	-0.084	0.437
ab	Indirect effect of loneliness on problematic use through anthropomorphism	0.052	0.064		-0.004	0.207

No significant associations were found between loneliness and either the number of days of AI chatbot use per week ($r = .052$, $p = .601$) or the average daily duration of interaction ($r = .083$, $p = .406$). Similarly, AI chatbot anthropomorphization was not significantly related to either the number of days of use per week ($r = .111$, $p = .269$) or the average daily duration of interaction ($r = .058$, $p = .563$). No significant association was observed between the number of days of AI chatbot use per week and the severity of problematic AI use ($r = .116$, $p = .248$). In contrast, a significant positive association emerged between average daily interaction time (in minutes) and the severity of problematic AI use ($r = .252$, $p = .010$).

DISCUSSION

The aim of the present study was to identify relationships between loneliness, AI anthropomorphization, and problematic AI chatbot use, with particular emphasis on the proposed role of anthropomorphization as a mediator. In addition, we exploratorily compared problematic use with quantitative indicators of usage time.

Usage patterns

School teachers face high job demands, including heavy workloads, accountability pressures, and ongoing reforms and organizational uncertainty. These demands are linked to lower well-being and job satisfaction (OECD, 2025). Hypothetically, for this reason, teachers may be especially likely to use AI tools for instrumental purposes such as increasing productivity, saving time, and reducing workload. In the examined group of teachers, instrumental motives were the most strongly endorsed,

whereas escapist and relational motives were reported at very low levels. Thus, consistent with previous literature (Li & Zhang, 2024; Yankouskaya et al., 2025), the present study suggests that AI may function primarily as a work-related tool through instrumental applications.

Moreover, the relatively low level of anthropomorphization (below 2 on a 1–5 scale) and social motivation (1.2 on a 1–5 scale) suggests that users who engage with AI chatbots mainly for professional purposes may be less influenced by the human-like characteristics of this technology. However, this interpretation should be made cautiously, as anthropomorphization was assessed using a self-report measure.

Consequently, the characteristics of the sample—education professionals with relatively high educational attainment and predominantly instrumental, work-related use of AI—create a specific context for examining phenomena related to anthropomorphization and relational engagement with AI.

Loneliness and Anthropomorphism

The results confirmed that loneliness was positively associated with AI chatbot anthropomorphization. Participants reporting higher levels of loneliness were more likely to attribute human-like qualities to AI systems. Importantly, this relationship remained significant after controlling for anxiety and depressive symptoms, suggesting that the association between loneliness and anthropomorphization cannot be explained solely by general emotional distress. This finding is consistent with the framework proposed by Epley et al. (2008), which holds that loneliness increases the tendency to humanize non-human entities.

However, the mediation analysis indicated that although loneliness was significantly associated with both anthropomorphization and problematic AI use, the indirect effect via anthropomorphization did not reach statistical significance. Likewise, the path from anthropomorphization to problematic use, after controlling for loneliness, anxiety, and depressive symptoms, did not reach significance. These findings suggest that loneliness and anthropomorphization are related constructs that may partly share common psychological foundations. Once both variables were considered simultaneously, their unique predictive contributions to problematic AI use were attenuated, indicating overlap in the variance they explain.

Several interpretations of this pattern are possible. One is that both variables may partly reflect broader dispositional factors. For example, anxious attachment style has been linked both to loneliness (Borawski, Sojda, Rychlewska, & Wajs, 2022) and to the tendency to anthropomorphize non-human objects (Norberg, Crone, Kwok, & Grisham, 2018). This highlights the importance of including personality-related variables in future research. An alternative explanation is that the relationship between loneliness, anthropomorphization, and problematic AI use may depend on users' motives for engaging with AI. Unlike Huang et al. (2024), who included declared motives for AI use in their statistical analyses, the present study focused primarily on loneliness, while motives were assessed only to characterize the sample. It is possible that loneliness is linked to problematic use via anthropomorphization mainly when chatbots serve social or relational functions rather than predominantly instrumental ones, with users' motives for AI use representing a

potential moderating factor in this relationship.

Such an interpretation is consistent with broader perspectives emphasizing that problematic or addictive behaviors may serve multiple psychological functions (Yankouskaya et al., 2025; Király et al., 2023; Li & Zhang, 2025). In our relatively homogeneous sample of teachers, who reported primarily instrumental motives for using AI chatbots, problematic use may have been more strongly related to the tool-like functions of this technology, such as supporting work tasks, reducing cognitive load, and facilitating everyday responsibilities, whereas relational aspects may have been less central. This does not exclude the relevance of emotion regulation, but suggests it may play a secondary role in this particular group. However, because motives were not examined as moderators in the present analyses, these interpretations should be treated with caution, and the current data do not allow firm conclusions regarding such conditional effects.

Time of Use

Furthermore, the findings indicate that the time spent using AI, as measured quantitatively, was less strongly related to anthropomorphization and loneliness than problematic use. Moreover, the association between usage time and problematic use itself was only small to moderate in magnitude. This is consistent with theoretical perspectives suggesting that the amount of time devoted to a given activity does not necessarily imply dysfunctional involvement (as shown, for example, in the context of video gaming; Billieux et al., 2019). Problematic AI use may therefore be more qualitative than quantitative, and depend rather on the psychological

meaning of the interaction than on its sheer frequency. Future research should assess multiple indicators of intensive AI use beyond simple time-based measures.

Limitations

Several limitations should be acknowledged. First, the study had a cross-sectional and correlational design. Although the hypotheses were grounded in prior literature, the data do not allow causal conclusions to be drawn. Second, due to the screening nature of the survey, brief measures (PHQ-4, UCLA-3) and author-developed scales and indexes (anthropomorphization, problematic use) were used. Although the latter were grounded in established frameworks—mind perception theory and ICD-11 behavioral addiction criteria—it cannot be ruled out that measurement limitations influenced the results. Nevertheless, the reported reliability estimates and factor analytic results (for PHQ-4, UCLA-3, and anthropomorphization) were satisfactory and support their usefulness. The problematic use scale showed limited reliability; however, it was conceptualized as a summed indicator of symptom severity rather than a homogeneous latent construct. Finally, the sample size ($N = 102$) was relatively modest. This may have limited the ability to detect small or moderate effects and may have reduced statistical power in the mediation analysis.

CONCLUSIONS

The present study contributes to understanding the psychological correlates of problematic AI chatbot use by highlighting the complex relationships among loneliness, anthropomorphization, and problematic use. The findings indicate

that although loneliness and anthropomorphization were both related to problematic use, their effects were not fully independent. This challenges a simple mediation model and suggests the presence of broader shared processes underlying these associations.

The study extends the emerging literature on problematic AI use to an occupational sample of teachers, a group that often uses AI chatbots primarily for instrumental and work-related purposes. The study showed that the overall level of anthropomorphization in our sample was relatively low. At the same time, loneliness was positively associated with anthropomorphism, even in this sample, suggesting that relationships between problematic use, AI anthropomorphization, and feelings of loneliness can also be observed in this group. Relational factors still showed meaningful associations with problematic use, indicating an important direction for future research.

Finally, the findings suggest that problematic AI chatbot use may depend more on the qualitative meaning and psychological functions of engagement than on usage frequency alone. This is consistent with the observed pattern in which time-based indicators showed weaker and less consistent associations than relational and psychological variables.

IMPLICATIONS FOR RESEARCH AND APPLICATION

Overall, these findings highlight the need for further research incorporating a broader range of psychological variables to better explain problematic engagement with AI systems. Future studies should examine potential moderators, e.g., motives for use, attachment style, and personality traits.

They should also distinguish between productivity-oriented, companion-oriented, and therapeutic AI systems, as their psychological effects may differ substantially.

The present findings further suggest that frequency or duration of AI use alone may be insufficient indicators of problematic engagement. Future research should therefore focus more strongly on the

functional consequences of AI use. Likewise, policies promoting healthy AI use should consider qualitative indicators such as dependency, loss of control, and functional impairment. Institutions implementing AI tools may benefit from monitoring not only adoption rates, but also signs of overreliance and disruptions to work–life balance.

REFERENCES

- Al-Obaydi, L. H., & Pikhart, M. (2026). Artificial intelligence addiction: Exploring the emerging phenomenon of addiction in the AI age. *AI & SOCIETY*, 41(2), 1577–1593. <https://doi.org/10.1007/s00146-025-02535-z>
- Billieux, J., Flayelle, M., Rumpf, H.-J., & Stein, D. J. (2019). High Involvement Versus Pathological Involvement in Video Games: A Crucial Distinction for Ensuring the Validity and Utility of Gaming Disorder. *Current Addiction Reports*, 6(3), 323–330. <https://doi.org/10.1007/s40429-019-00259-x>
- Borawski, D., Sojda, M., Rychlewska, K., & Wajs, T. (2022). Attached but Lonely: Emotional Intelligence as a Mediator and Moderator between Attachment Styles and Loneliness. *International Journal of Environmental Research and Public Health*, 19(22), 14831. <https://doi.org/10.3390/ijerph192214831>
- Chatterji, A., Cunningham, T., Deming, D., Hitzig, Z., Ong, C., Shan, C. Y., & Wadman, K. (2025). *How People Use ChatGPT* (No. w34255; p. w34255). Cambridge, MA: National Bureau of Economic Research. <https://doi.org/10.3386/w34255>
- Ciudad-Fernández, V., Von Hammerstein, C., & Billieux, J. (2025). People are not becoming “AIholic”: Questioning the “ChatGPT addiction” construct. *Addictive Behaviors*, 166, 108325. <https://doi.org/10.1016/j.addbeh.2025.108325>
- Epley, N., & Waytz, A. (2010). Mind Perception. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of Social Psychology* (1st ed.). Wiley. <https://doi.org/10.1002/9780470561119.socpsy001014>
- Epley, N., Waytz, A., Akalis, S., & Cacioppo, J. T. (2008). When We Need A Human: Motivational Determinants of Anthropomorphism. *Social Cognition*, 26(2), 143–155. <https://doi.org/10.1521/soco.2008.26.2.143>
- Feng, Z., & Dang, J. (2025). To avoid disconnection or approach connection: Loneliness predicts social robot anthropomorphism via different social motivations in the UK and China. *Personality and Individual Differences*, 235, 112979. <https://doi.org/10.1016/j.paid.2024.112979>
- Gray, H. M., Gray, K., & Wegner, D. M. (2007). Dimensions of Mind Perception. *Science*, 315(5812), 619–619. <https://doi.org/10.1126/science.1134475>
- Heinz, M. V., Mackin, D. M., Trudeau, B. M., Bhattacharya, S., Wang, Y., Banta, H. A., ... Jacobson, N. C. (2025). Randomized Trial of a Generative AI Chatbot for Mental Health Treatment. *NEJM AI*, 2(4). <https://doi.org/10.1056/AIoa2400802>
- Huang, S., Lai, X., Ke, L., Li, Y., Wang, H., Zhao, 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*, Volume 17, 1087–1102. <https://doi.org/10.2147/PRBM.S440889>
- Hughes, M. E., Waite, L. J., Hawkey, L. C., & Cacioppo, J. T. (2004). A Short Scale for Measuring Loneliness in Large Surveys: Results From Two Population-Based Studies. *Research on Aging*, 26(6), 655–672. <https://doi.org/10.1177/0164027504268574>

- Kim, H.-Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics*, 38(1), 52. <https://doi.org/10.5395/rde.2013.38.1.52>
- Király, O., Koncz, P., Griffiths, M. D., & Demetrovics, Z. (2023). Gaming disorder: A summary of its characteristics and aetiology. *Comprehensive Psychiatry*, 122, 152376. <https://doi.org/10.1016/j.comppsy.2023.152376>
- Kooli, C., Kooli, Y., & Kooli, E. (2025). Generative artificial intelligence addiction syndrome: A new behavioral disorder? *Asian Journal of Psychiatry*, 107, 104476. <https://doi.org/10.1016/j.ajp.2025.104476>
- Kroenke, K., Spitzer, R. L., Williams, J. B. W., & Lowe, B. (2009). An Ultra-Brief Screening Scale for Anxiety and Depression: The PHQ-4. *Psychosomatics*, 50(6), 613–621. <https://doi.org/10.1176/appi.psy.50.6.613>
- Larionow, P., & Karolina Mudło-Głagolska, K. (2023). The Patient Health Questionnaire– 4: Factor Structure, Measurement Invariance, Latent Profile Analysis of Anxiety and Depressive Symptoms and Screening Results in Polish Adults. *Advances in Cognitive Psychology*, 19(2), 123–137. <https://doi.org/10.5709/acp-0391-2>
- Li, H., & Zhang, X. (2025). *Is GPT Use Associated with Addiction? A Brief Research Report*. SSRN. <https://doi.org/10.2139/ssrn.5174256>
- Ma, S., & Koike, M. (2025). Becoming Human: How Perceived Anthropomorphism and Authenticity Influence Romantic Attractiveness of Chat Agents. *International Journal of Human–Computer Interaction*, 41(22), 14162–14175. <https://doi.org/10.1080/10447318.2025.2481211>
- Mariani, M. M., Hashemi, N., & Wirtz, J. (2023). Artificial intelligence empowered conversational agents: A systematic literature review and research agenda. *Journal of Business Research*, 161, 113838. <https://doi.org/10.1016/j.jbusres.2023.113838>
- Marriott, H. R., & Pitardi, V. (2024). One is the loneliest number... Two can be as bad as one. The influence of AI Friendship Apps on users' well-being and addiction. *Psychology & Marketing*, 41(1), 86–101. <https://doi.org/10.1002/mar.21899>
- Nass, C., & Moon, Y. (2000). Machines and Mindlessness: Social Responses to Computers. *Journal of Social Issues*, 56(1), 81–103. <https://doi.org/10.1111/0022-4537.00153>
- Naveed, H., Khan, A. U., Qiu, S., Saqib, M., Anwar, S., Usman, M., ... Mian, A. (2023). *A Comprehensive Overview of Large Language Models* (Version 10). Version 10. arXiv. <https://doi.org/10.48550/ARXIV.2307.06435>
- OECD. (2025). *Results from TALIS 2024: The State of Teaching*. OECD Publishing. <https://doi.org/10.1787/90df6235-en>
- Peng, C., Zhang, S., Wen, F., & Liu, K. (2025). How loneliness leads to the conversational AI usage intention: The roles of anthropomorphic interface, para-social interaction. *Current Psychology*, 44(9), 8177–8189. <https://doi.org/10.1007/s12144-024-06809-5>
- Sætra, H. S. (2023). Generative AI: Here to stay, but for good? *Technology in Society*, 75, 102372. <https://doi.org/10.1016/j.techsoc.2023.102372>
- Sağlam, R. K., & Kalanlar, B. (2025). Living with and without AI: A mixed-methods study on AI usage, addiction, and “AIlessphobia” in nursing students. *Nurse Education in Practice*, 88, 104530. <https://doi.org/10.1016/j.nepr.2025.104530>
- Salah, M., Abdelfattah, F., Alhalbusi, H., & Mukhaini, M. A. (2023, October 31). *Me and My AI Bot: Exploring the “AIholic” Phenomenon and University Students’ Dependency on Generative AI Chatbots - Is This the New Academic Addiction?* In Review. <https://doi.org/10.21203/rs.3.rs-3508563/v1>
- Shen, M. K., & Yoon, D. (2025). The Dark Addiction Patterns of Current AI Chatbot Interfaces. *Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems*, 1–7. Yokohama Japan: ACM. <https://doi.org/10.1145/3706599.3720003>
- 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>

- Wahde, M., & Virgolin, M. (2022). *Conversational Agents: Theory and Applications*. <https://doi.org/10.48550/ARXIV.2202.03164>
- Wang, W. (2017). Smartphones as Social Actors? Social dispositional factors in assessing anthropomorphism. *Computers in Human Behavior*, 68, 334–344. <https://doi.org/10.1016/j.chb.2016.11.022>
- Waytz, A., Heafner, J., & Epley, N. (2014). The mind in the machine: Anthropomorphism increases trust in an autonomous vehicle. *Journal of Experimental Social Psychology*, 52, 113–117. <https://doi.org/10.1016/j.jesp.2014.01.005>
- Yankouskaya, A., Liebherr, M., & Ali, R. (2025). Can ChatGPT Be Addictive? A Call to Examine the Shift from Support to Dependence in AI Conversational Large Language Models. *Human-Centric Intelligent Systems*, 5(1), 77–89. <https://doi.org/10.1007/s44230-025-00090-w>
- Zhai, C., Wibowo, S., & Li, L. D. (2024). The effects of over-reliance on AI dialogue systems on students' cognitive abilities: A systematic review. *Smart Learning Environments*, 11(1), 28. <https://doi.org/10.1186/s40561-024-00316-7>
- Zhang, X., Li, H., Yin, M., Zhang, M., Li, Z., & Chen, Z. (2025). Investigating AI Chatbot Dependence: Associations with Internet and Smartphone Dependence, Mental Health Outcomes, and the Moderating Role of Usage Purposes. *International Journal of Human–Computer Interaction*, 1–13. <https://doi.org/10.1080/10447318.2025.2545464>
- Zhang, X., Li, Z., Zhang, M., Yin, M., Yang, Z., Gao, D., & Li, H. (2025). Exploring artificial intelligence (AI) Chatbot usage behaviors and their association with mental health outcomes in Chinese university students. *Journal of Affective Disorders*, 380, 394–400. <https://doi.org/10.1016/j.jad.2025.03.141>
- Zimmerman, A., Janhonen, J., & Beer, E. (2024). Human/AI relationships: Challenges, downsides, and impacts on human/human relationships. *AI and Ethics*, 4(4), 1555–1567. <https://doi.org/10.1007/s43681-023-00348-8>

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Appendix 1

Anthropomorphism Scale - English translation of used scale

Please indicate the extent to which you agree with the following statements (1 = strongly disagree, 5 = strongly agree).

The AI chatbot I use sometimes gives the impression that it...

- ...is capable of thinking independently (e.g., analyzing, drawing conclusions).
- ...plans its responses or actions with a certain degree of purposefulness.
- ...remembers earlier parts of the conversation or information about me.
- ...has its own emotions or reacts in an emotional way.
- ...possesses some degree of consciousness.
- ...has its own personality or a characteristic way of being.

Appendix 2

Problematic Use Scale - English translation of used scale

Please indicate the extent to which you agree with the following statements (1 = strongly disagree, 5 = strongly agree).

- Using AI chatbots noticeably changes the balance between different areas of my life (e.g., study, relationships, rest).
- I sometimes use an AI chatbot more often than I originally intended.
- I sometimes continue using an AI chatbot even though I know it is not good for me (e.g., it takes time, distracts me, lowers my mood).

Appendix 3.

Polish Translation of UCLA-3 used in this study (original scale: Hughes et al., 2004)

Proszę zaznaczyć, jak często w ostatnim czasie doświadczał(a) Pan(i) opisanych poniżej uczuć lub sytuacji (1 – prawie nigdy, 2 – czasami, 3 – często).

Jak często ma Pan(i) poczucie, że brakuje Panu(i) towarzystwa?

Jak często czuje się Pan(i) pomijany/a?

Jak często czuje się Pan(i) odizolowany/a od innych?

Appendix 4

AI Chatbot Use Motives Scale

Please indicate the extent to which you agree with the following statements (1 = strongly disagree, 5 = strongly agree).

I use AI chatbots...

- ...to distract myself from stress, problems, or unpleasant thoughts.
- ...when I feel lonely or need contact with someone.
- ...to obtain information, learn, and develop my skills.
- ...because I enjoy it, it helps me relax, and it provides entertainment.