AI as a Digital Companion: Exploring the Relationship Between Generative AI Dependency and Perceived Loneliness in International Students

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Abstract: This Bachelor thesis investigates the relationship between generative AI (GenAI) dependency and perceived loneliness among international students. As GenAI tools like ChatGPT become more embedded in student life, questions arise about their emotional impact. Using survey data from international students, the study examines whether dependency on GenAI is associated with greater or reduced loneliness. Statistical analyses revealed that higher GenAI dependency correlates with increased loneliness, even after accounting for age, gender, time abroad, and personality traits. Emotional motivation for AI use did not significantly influence this relationship, though low emotional stability strongly predicted loneliness. These findings suggest that rather than mitigating loneliness, GenAI may be used as a coping mechanism by students already experiencing emotional disconnection. The study contributes to a growing body of research on digital emotional support and highlights the importance of integrating balanced, human-focused strategies into student well-being initiatives in higher education.

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Generative AI, Loneliness, International Students, Mental Health, AI interaction, Digital Dependency

During the preparation of this work, the author used CHAT GPT and DEEP L in order to refine his work by checking for grammar, sentence structure, image creation, spelling and support. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the work."

1. INTRODUCTION

Increased mobility at the student level has significantly redefined higher education, firmly embedding international students in university life globally. Foreign education offers unprecedented opportunities for personal, academic, and professional development but, in doing so, also poses enormous emotional and psychological challenges. International students encounter various challenges, including homesickness, difficulties with cultural adaptation, language barriers, and social exclusion, all of which have a significant impact on their psychological health and well-being (Misirlis et al., 2020; Zheng et al., 2023).

Social isolation and loneliness among international students have been described as pressing public health concerns, given their severe consequences, such as depression, anxiety, academic decline, and even suicidality (Zheng et al., 2023). Rejection, feeling trapped, and disrupted social networks are persistent challenges that many international students face. As Zheng et al. (2023) argue, there is an urgent need for accessible and scalable forms of support that can offer emotional connection and alleviate these burdens.

One emerging solution gaining attention is the use of generative artificial intelligence (GenAI) in the form of conversational chatbots such as ChatGPT, Replika, and YouChat. These systems, powered by large language models (LLMs), enable real-time, interactive conversations that may simulate empathetic listening, emotional validation, and companionship. For international students who may struggle with building immediate in-person connections, GenAI offers a low-barrier, always-available source of interaction. Empirical research has demonstrated that GenAI tools can enhance emotional well-being through mechanisms such as mood tracking, cognitive reframing, and stress reduction (Yu, 2024; Fu & Liu, 2023). Furthermore, studies by Hoermann et al. (2017) and Bibault et al. (2019) demonstrate that such tools can mimic key aspects of therapeutic dialogue, including responsive listening and emotional mirroring.

These advantages are most applicable to overseas scholars, who may be deprived of suitable or non-stigmatising mental health care. Kushlev et al. (2025) and Chin et al. (2023) argue that AI-mediated emotional support may be most effective when existing traditional support networks are inadequate or non-existent. Furthermore, Bickmore et al. (2005) assert that users' perceptions of AI systems' emotional intelligence directly correlate with feelings of comfort and trust. Thus, GenAI can be an undeniably strong yet underdeveloped coping tool for contexts in postsecondary education.

Despite this promise, we observe an evident shortage of empirical research directly exploring the usage of GenAI and subjective self-perceived loneliness among international students. This relationship must be understood in order to determine whether GenAI can meaningfully enhance students' emotional well-being and social integration or if its usage is merely supplemental and short-term.

This research provides evidence to help fill this gap through an examination of whether dependence on generative AI is related to international postgraduates' attitudes toward loneliness, which yields interesting results in terms of the impact of new technology on mental support for students.

1.2 Research Question

"To what extent is there a relationship between generative AI dependency and perceived loneliness among international students?"

International students are faced with unique difficulties when they are getting adjusted to unfamiliar learning and cultural environments. Such difficulties invariably include acculturative stress, language barriers, homesickness, social isolation, financial burden, and additional academic pressure, all having severe implications for their total well-being and mentality (Fu & Liu, 2023). Rahman and Kohli (2024) identify that international students often experience anxiety and depression owing to such factors, highlighting why quality mental health attention specifically targeted toward this group is so desperately needed. Fostering this cause further, Misirlis, Zwaan, and Weber (2020) note that international students experienced greater amounts of loneliness, depression, and pressure during COVID-19, illustrating their additional susceptibility in times of crises.

Recent advances in artificial intelligence (AI) demonstrate promising potential in supporting treatment for mental health disorders such as depression, anxiety, and loneliness (Abd-Alrazaq et al., 2021; Fitzpatrick et al., 2017). Specifically, generative AI systems utilising natural language processing (NLP) can deliver timely psychological interventions in an accessible, user-friendly format. Yu (2024) highlights how enhanced active listening capabilities in chatbots can provide emotional support and alleviate feelings of loneliness by simulating empathic interactions.

However, despite these benefits, generative AI-driven chatbots also present risks. Research shows that such systems may lack the ability to detect crisis situations or harmful ideation and may even inadvertently reinforce maladaptive thinking by mirroring the user's tone or agreeing with distressing prompts (Coppersmith et al., 2022; Benton et al., 2021). Moreover, the absence of genuine empathy and human judgment can lead to misinterpretations of nuanced emotional cues, potentially worsening users' mental states (Dehbozorgi et al., 2025). As such, while chatbot interventions hold substantial promise, they must be carefully designed, regularly audited, and ideally supplemented by human oversight in sensitive contexts.

The deployment of generative AI tools may also depend on how long undergraduate students have been abroad, as different stages of cultural adaptation can affect how these students engage with such interventions and the types of emotional support they require (Rahman & Kohli, 2024). Additionally, Dehbozorgi et al. (2025) highlight both the opportunities and ethical complexities inherent in generative AI, particularly regarding privacy, algorithmic transparency, and cultural appropriateness. These ethical considerations underscore the need for generative AI interventions to be carefully designed, thoroughly evaluated, and culturally sensitive to ensure they are safe, relevant, and genuinely beneficial.

In spite of the high prospects of generative AI technologies, there is limited empirical research focusing particularly on how length of stay moderates the impact of AI use on international students' feelings of perceived loneliness. It is important to address this gap in order to improve and customize AI-related mental health intervention strategies to suit changing international students' needs during their process of adaptation.

1.3 Hypothesis

Hypothesis I

H1: There is a negative correlation between generative AI dependency and perceived loneliness among international students.

The digitalization of higher education and communication has created new forms for emotional and social support, and generative artificial intelligence (GenAI) is a standout development. Applications like ChatGPT based on large language models are able to mimic human-like conversation and offer individuals real-time, customized interactions. These qualities make GenAI a potential support for international postsecondary students a population especially exposed to loneliness through cultural dislocation, language differences, and diminished access to known support networks.

Subjective loneliness, or the feeling that one is not connected in a meaningful way, is not uncommon among international students making educational and cultural transitions (Zheng et al., 2023). While most institutions provide official support services, such services might be inadequate, ethnoculturally insensitive, or unused. GenAI might, therefore, be presented as an additional or substitute tool, providing an interactive and nonjudgmental platform through which students might be able to communicate feelings, seek reassurance, or be heard even when they are not receiving face-to-face human interaction.

Earlier research has pointed to GenAI's emotional regulation potential. Research conducted by Yu (2024) and Fu and Liu (2023) indicate GenAI can support users in emotional distress management through calming reactions, cognitive restructuring, and virtual companionship. Based on such functions, it is feasible to assume that greater dependency on GenAI in place of simple frequency of GenAI use might be correlated to reduced degrees of loneliness among international students.

This hypothesis is exploratory and based on emerging research suggesting that GenAI may offer emotional support in the absence of face-to-face interaction. However, given the mixed findings in existing literature, the direction of the relationship remains uncertain and will be interpreted cautiously.

This hypothesis will be validated through an examination of participants' GenAI dependency, as measured through the Digital Attachment to AI (DAI) measure, and loneliness, measured through the short-form UCLA Loneliness Scale. The multiple regression equation will be employed to examine whether GenAI dependency is a significant predictor of loneliness after controlling for potential control variables.

If supported, this hypothesis will suggest that GenAI tools are not merely digital conveniences but may also serve as accessible and psychologically meaningful coping mechanisms for students navigating the emotional complexities of studying abroad.

1.4 Hypothesis II

H2: International students who use generative AI tools primarily for emotional support report higher levels of perceived loneliness compared to those who do not.

This hypothesis builds on the first by investigating whether the relationship between GenAI dependency and loneliness is influenced by emotionally motivated use. Rather than assessing GenAI usage in general, it focuses on students who turn to AI for emotional functions such as reassurance, venting, or stress relief, exploring whether these motivations intensify feelings of loneliness.

Prolonged loneliness, particularly in unfamiliar cultural settings, can prompt individuals to seek alternative forms of emotional connection (Sawir et al., 2008; Cacioppo & Patrick, 2008). For international students, barriers such as language, unfamiliar social norms, and physical distance from home may hinder traditional support systems (Ward et al., 2001). In this context, GenAI can serve as an accessible and non-judgmental space for expressing emotions or simulating social interactions in a culturally neutral manner.

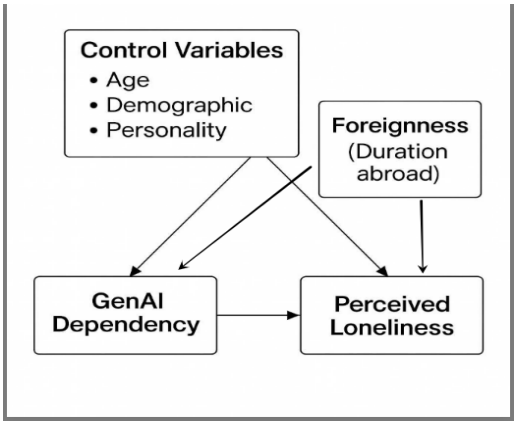
Zheng et al. (2023) document how international students often report feeling excluded and misunderstood during the early stages of cultural transition. Without sufficient social anchors, many turn to digital alternatives. Chin et al. (2023) further demonstrate that lonely or socially anxious students are more likely to intentionally use GenAI as a substitute for emotional connection particularly during moments of distress or unmet social needs.

To test this hypothesis, participants are categorised based on whether they report using GenAI for emotional support (e.g., venting or seeking reassurance) versus non-emotional purposes (e.g., academic assistance). A moderated regression model, a statistical method that examines the relationship between a predictor variable and an outcome variable, while also considering the influence of a third variable (the moderator), is then used to assess whether emotionally motivated GenAI use intensifies the relationship between GenAI dependency and perceived loneliness.

GenAI dependency is measured using the Digital Attachment to AI (DAI) scale, a five-item instrument developed by Morales et al. (2023) that assesses users' emotional and behavioural reliance on generative AI tools. The DAI scale is significant in this study as it provides a structured way to measure the emotional and behavioural aspects of GenAI use. Perceived loneliness is measured using the short-form UCLA Loneliness Scale, a widely used 8-item measure that captures subjective feelings of social isolation and lack of connection (Hughes et al., 2004). The UCLA Loneliness Scale is significant as it provides a reliable and valid measure of loneliness, a key variable in this study. This procedure allows for an evaluation of whether the link between GenAI dependency and loneliness is stronger among those who engage with GenAI for emotional reasons.

If supported, the findings suggest that emotionally driven GenAI use reflects more profound emotional vulnerability rather than casual engagement. This could position GenAI not simply as a functional tool but as a meaningful source of support for students navigating emotional strain during cultural adjustment. Such insights could inform mental health strategies and interventions targeting international students who are isolated.

Figure 1: Conceptual Model



2. LITERATURE REVIEW

2.1 Defining Generative AI: Conversational AI and Chatbot Capabilities

Generative AI (GenAI) in the form of conversational interfaces such as ChatGPT is a dramatic advancement in the use of large language models (LLMs). They can generate coherent, context-sensitive, and affective responsive conversation, mimicking interaction in a manner similar to that of a person. They can be applied in a variety of contexts, but in the mental health area, GenAI technologies offer promise in enhancing emotional self-regulation, decreasing distress, and providing support similar to that approximated by cognitive-behavioral treatments (Fu & Liu, 2023; Yu, 2024; Bibault et al., 2019). Further investigation has underscored that GenAI technologies can serve as low-threshold gateways to self-reflection and affect validation (Hoermann et al., 2017; Morris et al., 2018).

A. The Nature of Human-GenAI Interaction

While users often report satisfaction, empathy, and comfort from these interactions, frustrations may also arise. These can stem from limitations in the AI's understanding of complex emotional states, repetitive responses, or a perceived lack of genuine human empathy (Dehbozorgi et al., 2025). The dual potential for satisfaction and frustration underscores the importance of understanding user needs and expectations when deploying GenAI in emotionally sensitive contexts.

2.2 Defining Social Isolation and Loneliness

A**. Distinction Between Social Isolation and Loneliness**

Social isolation refers to an objective deficiency in social contact or relationships, quantifiable through metrics such as frequency of interactions or network size (Cacioppo & Cacioppo, 2014). Loneliness, by contrast, is a subjective emotional state that emerges when a person's actual social relationships do not meet their expectations for connection or intimacy (Peplau & Perlman, 1982). It is thus possible for individuals to feel lonely even in the presence of others. Heinrich and Gullone (2006) emphasize that loneliness is prevalent during key transitional phases such as relocation, making international students particularly susceptible.

B. **Psychological Impact**

Both social isolation and loneliness have been empirically linked to adverse mental health outcomes including depression, anxiety, diminished cognitive function, and even increased mortality risk (Holt-Lunstad et al., 2015; Cacioppo et al., 2010). International students face higher psychological risks due to language barriers, acculturative stress, and the absence of familiar support networks. Misirlis et al. (2020) found that these students frequently experience loneliness and related psychological symptoms. Russell (1996), in validating the UCLA Loneliness Scale, established loneliness as a reliable and significant predictor of mental well-being, reinforcing its relevance in academic mental health research.

C. **Loneliness and Technology Use**

Recent studies suggest that technology and particularly AI driven conversational agents play an increasingly central role in how individuals manage emotional distress and loneliness. Tools such as ChatGPT provide immediate, always available, and judgment free dialogue, which can help users cope with emotional vulnerability and self-expression needs (Yu, 2024; Fu & Liu, 2023). Chin et al. (2023) found that students with high levels of social anxiety or perceived loneliness are more likely to engage with AI for emotional support, positioning GenAI tools as an alternative to traditional support mechanisms. Kushlev et al. (2025) further argue that the perception of empathy in these tools' fosters user attachment and emotional relief. Moreover, Gaffney et al. (2019) and Morris et al. (2018) highlight how conversational agents can facilitate emotional reflection and reinforce psychological resilience.

2.3 *Relationship Between Generative AI Despondency and Social Isolation Among International Students*

This study focuses in on three interrelated factors: international students, perceived loneliness, and generative AI dependency. GenAI is not a replacement for human support, even though literature proposes that GenAI can be an emotionally significant outlet where more traditional support or psychological support is not feasible (Dehbozorgi et al., 2025; Chin et al., 2023). Park et al. (2022) note that AI mediated communication via affective language can duplicate social presence something that is significant for individuals in situations of emotional vulnerability.

Given the dynamic and affective nature of loneliness, and the responsiveness and accessibility of GenAI, it is important to empirically investigate the relationship between these variables. By narrowing its scope to this specific student demographic and context, the current study aims to offer new insights into the intersection of digital companionship and student mental health. This research contributes to a growing body of work that advocates for the strategic and culturally sensitive integration of GenAI tools into higher education environments.

3. METHODOLOGY

3.1 Research Design

This study will use a quantitative, cross-sectional research design to explore the relationship between generative AI dependency and perceived loneliness among international students. The approach is chosen to allow for the collection of standardized data from a diverse group of international students at a single point in time, providing insights into potential correlations between AI dependency and feelings of loneliness.

3.2 Sample Size

To determine the appropriate sample size, G*Power analysis was conducted (Heinrich Heine Universität Düsseldorf, 2020). The analysis was based on a multiple regression model with five predictors, a power level set at 95%, and a significance threshold of 0.05(alpha of 0.05). This yielded a minimum recommended sample size of 146 participants. However, due to the survey being shared with two other students conducting similar research, the final sample consisted of 181 complete responses, thus exceeding the required threshold and ensuring more robust statistical power.

3.3 Participants

The target sample comprised international students enrolled in undergraduate or postgraduate courses at universities outside their country of origin. Participants were selected using a purposive sampling approach based on the following inclusion criteria: (1) non-domestic student status, (2) current enrolment in a university located in a country different from their home country, and (3) use of generative AI tools (e.g., ChatGPT, DeepSeek, Gemini) within the past six months. Recruitment was conducted through university email lists, student associations,

and online communities such as WhatsApp and Instagram groups catering to international students.

3.4 Variables and Operationalization

The independent variable in this study is generative AI dependency, which was measured using the Digital Attachment to AI (DAI) scale developed by Morales et al. (2023). This five-item instrument captures participants' emotional and behavioural reliance on generative AI tools such as ChatGPT or Gemini. While three of the five items directly assess emotional closeness and support-seeking behaviour (e.g., "I seek out AI when I'm feeling overwhelmed emotionally"), all five were included to ensure methodological consistency and a comprehensive assessment. Responses were recorded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), and scores were summed to calculate each participant's total DAI score. This variable was operationalized as a continuous predictor in all statistical models, in line with common practice in studies utilizing Likert-type summative scales (Morales et al., 2023).

To further contextualize this dependency, participants were asked to indicate both the frequency of their GenAI usage and the primary reason for which they used such tools. Usage intent was captured using a multiple-choice format with predefined categories, including emotional support (e.g., stress relief or venting), academic support (e.g., clarification of course material), and practical functions (e.g., writing assistance or translation). These additional variables enabled more nuanced analysis. In particular, frequency of emotional use was measured through a single-item scale: "I use AI tools when I feel uncertain or emotionally overwhelmed." Responses were recorded on a 5-point Likert scale (1 = Never, 5 = Very Often). This score was treated as a continuous moderator and mean cantered before being entered into the moderation analysis. The interaction term between emotional motivation and GenAI dependency was tested in a multiple linear regression model using the lm () function in R, with the interaction specified using the asterisk syntax (e.g., DAI_total * emotional_support).

The dependent variable, perceived loneliness, was measured using the 8-item short form of the UCLA Loneliness Scale (Russell, 1996), a widely used instrument for assessing subjective experiences of social disconnection. Participants rated items such as "I feel left out" and "I lack companionship" on a 4-point Likert scale ranging from 1 (Never) to 4 (Often). All responses were summed to compute a composite loneliness score for each participant, with higher scores indicating more intense perceived loneliness. The scale demonstrated high internal consistency in this study (Cronbach's $\alpha = 0.91$). This variable was operationalized as a continuous dependent variable and used in correlation analysis (cor.test ()), one-way ANOVA (aov ()), and multiple regression (lm()).

Personality traits were measured using the 10-item Mini-IPIP scale (Donnellan et al., 2006), which assesses five personality dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Intellect/Openness. Each dimension was represented by two items, answered on a 7-point Likert scale ranging from 1 (disagree strongly) to 7 (agree strongly). Items 6 to 10 were reverse coded before analysis. For each trait, a mean score was calculated and treated as a continuous control variable in the multiple regression model.

Additional control variables included age, gender, duration of time spent abroad, and whether the participant was currently studying in a country different from their country of origin. Age was treated as a continuous variable. Gender was treated as a binary variable (coded 1 = male, 2 = female) and included as a dummy-coded control. Duration abroad was measured using a 5-point ordinal scale (1 = less than 3 months, 5 = more than 5 years) and was treated as a continuous control variable in the main regression models. A categorical version of this variable was also tested and included in the Appendix C. All demographic controls were included to adjust for potential confounding effects.

All statistical analyses were conducted in R (v4.5.0). Descriptive statistics were calculated using base R functions. Pearson correlations were computed using cor.test(), group differences were analysed using one-way ANOVA via the aov() function, and multiple linear regressions were estimated using the lm() function. Interaction effects were tested by specifying interaction terms directly in the regression formula (e.g., lm(loneliness ~ DAI_total * emotional_support + controls)).

3.5 Data Collection

Data were collected over a three-week period through an anonymous online survey hosted on Qualtrics. The survey began with an informed consent form, which outlined the purpose of the study, the voluntary nature of participation, and assurances of confidentiality. After providing consent, participants were directed to a series of demographic questions, including age, gender, duration abroad, and whether they were studying in a country different from their country of origin. This was followed by using a ten-scale personality trait then, the 8-item short-form UCLA Loneliness Scale, which assessed participants' subjective feelings of social isolation. The final section of the survey included the five-item Digital Attachment to AI (DAI) scale, as well as additional questions regarding participants' frequency and purpose of generative AI usage.

The survey was designed to take approximately 5–7 minutes to complete and was optimized for both desktop and mobile devices to ensure accessibility. The option of conducting the survey in English and Dutch was given. Survey links were distributed via platforms commonly used by international students, including Instagram, WhatsApp groups, and LinkedIn communities. The accompanying invitation message briefly explained the study's relevance to international student experiences and encouraged voluntary, anonymous participation.

The survey was part of a broader data collection effort shared with two fellow students working on related but distinct research topics. While all participants completed the same survey, only the variables relevant to this study demographic information, the UCLA Loneliness Scale, ten scale personality trait, the Digital Attachment to AI (DAI) scale and GenAI usage questions were analyzed for the current thesis.

3.6 Data Analysis

Survey data was cleaned, coded, and transferred to R for statistical analysis. This included removing incomplete responses, filtering non-binary gender responses due to small cell sizes, and ensuring only complete data entries ($n = 93$) were retained. The analysis process was structured to align with the study's hypotheses and primary research question regarding the relationship between generative AI dependency and perceived loneliness among international students.

Descriptive statistics were computed for all variables to outline demographic characteristics and central tendencies for both the UCLA Loneliness Scale and the Digital Attachment to AI (DAI) scale. A total score was computed for each, and internal reliability was assessed using Cronbach's alpha. The DAI scale demonstrated excellent reliability ($\alpha = 0.93$), while the UCLA Loneliness Scale also showed strong internal consistency ($\alpha = 0.91$).

In line with standard practice in psychological and behavioural research, both scales were treated as continuous variables in the correlation and regression analyses. Summing or averaging Likert-type items into composite scores and treating them as interval-level predictors is widely supported, particularly when internal reliability is high (Norman, 2010; Morales et al., 2023). This approach enables greater statistical power and preserves information across the entire response scale.

Additionally, the dataset included self-reported personality traits, as assessed using the Ten-Item Personality Inventory (TIPI), with each trait scored on a 7-point Likert scale. Reverse coding was done then each assigned by average of 2 items per trait. Then Mean scores were calculated for each trait, and these were likewise treated as continuous control variables in the regression models. As with other validated personality instruments (e.g., Big Five scales), using mean trait scores as continuous variables is a common and accepted approach (Gosling et al., 2003; Donnellan et al., 2006).

To ensure robustness and transparency, categorical versions of key scales (e.g., low, medium, and high levels of loneliness and emotional stability) were also computed using tertiles and tested separately via ANOVA and categorical regression. These alternative operationalizations are presented in Appendix A.

To test the first hypothesis, Pearson's correlation coefficient was calculated to examine the bivariate relationship between DAI scores and UCLA loneliness scores. To address the second hypothesis, whether students who use AI for emotional support experience a stronger association between AI dependency and loneliness, a multiple linear regression was conducted. This model included loneliness as the dependent variable, with DAI total score, age, gender, and duration abroad as predictors. An interaction term between DAI and emotional-use intent was also tested. Emotional use was measured using a 5-point Likert scale item ("I use AI for emotional support," with responses ranging from 1 (Never) to 5 (Very Often). This allowed for a moderation analysis examining whether the strength of the association between AI dependency and loneliness varied depending on whether the participant used AI for emotional reasons.

Control variables included age, gender, time abroad, and the newly added TIPI personality scores. To explore potential group differences, two independent sample t-tests were conducted to assess differences in loneliness across gender and country-of-origin groups. For the ANOVA, GenAI dependency (measured using the DAI scale) was operationalized as a categorical variable by dividing scores into tertiles (low, medium, high). This method was chosen to detect nonlinear or threshold effects in loneliness across levels of GenAI dependency, an approach commonly used in exploratory psychological research when distribution-based cutoffs can reveal meaningful group-level differences.

In contrast, for the correlation and regression analyses, the DAI total score was treated as a continuous variable, reflecting standard practice when using Likert-type scale sums in predictive models (Morales et al., 2023). This allowed for greater statistical power and precision when examining the linear association between GenAI dependency and loneliness. The choice to use different operationalizations is intentional and methodologically justified: the categorical approach helps explore group differences and potential nonlinearity, while the continuous approach retains information for predictive modelling. Both approaches are reported, with the categorical variant detailed in Appendix A and B for transparency. As a robustness check, several exploratory regression models were estimated using relevant subsamples and interaction terms. These models tested whether the relationship between GenAI dependency and loneliness held across different contexts, including by country of origin, by students' emotional use of GenAI, and by reported feelings of disconnection. While the core effect of GenAI dependency remained statistically significant across most models, specific subgroup differences (e.g., based on emotional motivation or region) were not statistically significant. Detailed results of these exploratory models are presented in Appendix B.

All statistical tests were evaluated at a significance threshold of $p < .05$. Results were interpreted per the hypotheses and theoretical framing, using both main effects and interaction terms where appropriate.

3.7 Ethical Considerations

Ethical approval has been approved from the university's ethics committee of behavioural, Management and social sciences, approval number 251465, prior to data collection. Participation in the study is entirely voluntary and anonymous. No identifiable data will be collected. Data will be solely used for the purposes of this research. Participants will have the opportunity to withdraw their responses at any point before final submission.

This methodology is designed to ensure reliability, validity, and ethical integrity while enabling a robust examination of how generative AI tools may relate to international student's experiences of perceived loneliness.

4. RESULTS

This section presents the statistical results of the study examining the relationship between generative AI (GenAI) dependency and perceived loneliness among international students. The analyses include descriptive statistics, correlation analysis, ANOVA, multiple regression models, and interaction and personality control tests. All analyses were conducted in R using a cleaned dataset of 93 respondents who fully completed all relevant items.

Descriptive statistics were computed for the main study variables, including age, gender, duration abroad, GenAI dependency (DAI total), loneliness (UCLA total), and AI use for emotional support. The mean UCLA Loneliness Score was 15.86 (SD = 5.51), and the mean DAI Score was 8.66 (SD = 4.50). Respondents reported an average score of 1.87 (SD = 1.18) on the AI for emotional support item, measured on a 1–5 scale. Age (M = 1.20, SD = 0.43), gender (M = 1.53, SD = 0.50), and duration abroad (M = 4.26, SD = 1.04) also reflected a relatively young, gender-balanced sample, with most respondents having been abroad for over a year. Gender breakdown showed 44 males and 49 females.

Table 1: Descriptive statistics

Variable	Mean	SD	Min	Max	Skewness	Kurtosis
Age	1.2	0.43	1	3	1.84	2.39
Gender	1.53	0.5	1	2	-0.11	-2.01
Duration Abroad	4.26	1.04	1	5	-1.26	0.5
DAI Total	8.66	4.5	5	22	1.03	-0.06
UCLA Total	15.86	5.51	8	29	0.51	-0.46
AI for Emotional Support	1.87	1.18	1	5	1.15	0.2

Note: Gender is binary coded with 1= Male and 2 = Female.

To examine Hypothesis 1, a Pearson correlation test was performed between DAI total and UCLA total scores. The analysis revealed a statistically significant positive correlation, $r = 0.455$, $p < .001$. This indicates that higher scores on the Digital Attachment to AI (DAI) scale were associated with higher loneliness scores. In simple terms, individuals who showed greater dependency on GenAI also reported feeling lonelier. The correlation suggests a moderate effect size as $R^2 = 0.21$, meaning that around 21% of the variance in loneliness can be accounted for by gen ai dependency alone in this bivariate analysis

Table 2: Correlation

Variable	DAI Total	UCLA Total	AI Emotional Use	Emotional Stability
DAI Total	1	0.46	0.73	0.04
UCLA Total	0.46	1	0.41	0.43
AI Emotional Use	0.73	0.41	1	0
Emotional Stability	0.04	0.43	0	1

To further investigate how loneliness differed across levels of GenAI dependency, DAI scores were split into tertiles representing low, medium, and high dependent groups since this approach helps spot thresholds or nonlinear effects. A one-way ANOVA revealed a statistically significant difference in loneliness across these groups, $F(2, 90) = 9.42$, $p < .001$. Tukey's HSD post-hoc tests showed that the high group had significantly higher UCLA scores than both the low (mean difference = 4.48, $p = .002$) and medium dependent groups (mean difference = 5.13, $p < .001$). The difference between the low and medium groups was not statistically significant ($p = .87$). The effect size for this ANOVA, measured using eta squared ($\eta^2 = 0.173$), suggests that approximately 17.3% of the variance in loneliness scores can be explained by differences in GenAI dependency levels. This represents a large effect size, indicating a meaningful difference between the groups.

Table 3: One way ANOVA and Post Hoc Turkey HSD

One way ANOVA UCLA by DAI Group					
Source	Df	Sum Sq	Mean Sq	F value	Pr(>F)
DAI Group	2	483.9	241.95	9.421	<.001
Residuals	90	2311.3	25.68		
Post-Hoc Turkey HSD Test					
Comparison	Mean Difference	95% CI (Lower-Upper)	p-value		
Medium vs Low	-0.65	(-3.71 to 2.42)	0.871		
High vs Low	4.48	(1.42 to 7.55)	0.002		
High vs Medium	5.13	(2.06 to 8.20)	<0.001		

A multiple linear regression analysis was performed to further test Hypothesis 1 by examining whether DAI total significantly predicted loneliness scores while controlling for age, gender, and duration abroad. The model was statistically significant overall, $F(4, 88) = 6.82$, $p < .001$, with an R^2 value of 0.237. DAI total was a statistically significant predictor ($\beta = 0.5315$, $p < .001$), while age ($\beta = -0.991$, $p = .417$), gender ($\beta = -0.404$, $p = .702$), and duration abroad ($\beta = -0.744$, $p = .145$) were not statistically significant. This suggests that within this sample, GenAI dependency was uniquely associated with loneliness, whereas age, gender, and time abroad were not. The partial R^2 for DAI in this model was 0.198 indicating a large effect size, meaning gen ai dependency was a strong and unique predictor of loneliness.

Table 4: Hypothesis 1 Regression

Variable	Estimate	Std. Error	t value	p value
(Intercept)	16.2391	3.1374	5.176	1.42E-06
DAI Total	0.5315	0.1172	4.536	1.81E-05
Age	-0.9914	1.2155	-0.816	0.417
Gender	-0.404	1.051	-0.384	0.702
Duration Abroad	-0.7442	0.5057	-1.471	0.145
Multiple R-squared		0.2368		
Adjusted R-Squared		0.2021		
F-statistic		F(4,88) = 6.824		

To test Hypothesis 2, which proposed that emotional motivation for GenAI use may moderate the relationship between AI dependency and loneliness, an interaction term between DAI total and a centered version of the AI-for-emotional-support variable was included in a second regression model. The overall model was statistically significant, $F(6, 86) = 4.648$, $p < .001$, with an R-squared of 0.245. DAI total remained a significant predictor of loneliness ($\beta = 0.410$, $p = .022$). However, the interaction term between DAI and emotional support use was not statistically significant ($\beta = 0.017$, $p = .864$), nor was the emotional support variable itself ($\beta = 0.418$, $p = .742$). This suggests that, in this sample, the relationship between GenAI dependency and loneliness does not significantly differ based on how often the AI is used for emotional support. The partial R^2 for DAI in this model was 0.054 indicating a moderate effect size, while the interaction term showed negligible effect, suggesting the relationship between Gen ai dependency and loneliness did not meaningfully differ based on emotional usage levels in this sample

Table 5: Hypothesis 2 regression

Variable	Estimate	Std. Error	t value	p value
(Intercept)	16.1606	3.9362	4.106	9.15E-05
DAI Total	0.3779	0.2915	1.296	0.198
AI Emotional Support	0.4183	1.2648	0.331	0.742
Age	-0.975	1.2332	-0.791	0.431
Gender	-0.3988	1.0582	-0.377	0.707
Duration Abroad	-0.6836	0.5132	-1.332	0.186
DAI x Emotional Support	0.017	0.0988	0.172	0.864
Multiple R-squared		0.2449		
Adjusted R-squared		0.1922		
F-statisitc		F(6,86) = 4.648		

Finally, a third multiple regression model was constructed to explore whether adding personality traits would improve the prediction of loneliness. The model included the Big Five personality traits (Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness), alongside the original predictors. The overall model was statistically significant, $F(9, 83) = 7.48$, $p < .001$, and explained 44.8% of the variance in loneliness scores (adjusted R-squared = 0.388). DAI total ($\beta = 0.548$, $p < .001$) and Emotional Stability ($\beta = 1.447$, $p < .001$) were statistically significant predictors. The remaining personality traits and demographic controls were not significant (e.g., Conscientiousness $\beta = -0.762$, $p = .066$; gender $\beta = -1.277$, $p = .188$). This suggests that among the personality traits, only Emotional Stability showed a significant association with loneliness. As with previous models, nonsignificant variables should be interpreted as showing no evidence of a relationship in this sample, without assuming this generalizes to other populations. The effect size for DAI in this model using partial R2 was 0.083 thus remained moderate while emotional stability had a large effect size with a partial $R^2 = 0.224$ indicating it was the strongest predictor of loneliness in this extended model

Table 6: Personality trait Regression

Variable	Estimate	Std. Error	t value	p value
(Intercept)	14.0615	4.9055	2.866	0.00526
DAI Total	0.5482	0.1134	4.834	6.06E-06
Extraversion	0.1946	0.3193	0.609	0.54387
Agreeableness	-0.3838	0.3988	-0.962	0.33864
Conscientiousness	-0.7615	0.408	-1.866	0.06555
Emotional Stability	1.4475	0.3447	4.199	6.69E-05
Openness	0.221	0.5107	0.433	0.66635
Age	-0.5633	1.0869	-0.518	0.60568
Gender	-1.2767	0.9612	-1.328	0.18776
Duration Abroad	-0.5527	0.4805	-1.15	0.2534
Multiple R-squared		0.448		
Adjusted R-squared		0.3881		
F-statisitc		F(9,83)= 7.483		

As a robustness check, several exploratory regression models were estimated using relevant subsamples and interaction terms. These models tested whether the relationship between GenAI dependency and loneliness held across different contexts, including by country of origin, by students' emotional use of GenAI, and by reported feelings of disconnection. While the core effect of GenAI dependency remained statistically significant across most models, certain subgroup differences (e.g., based on emotional motivation or region) were non-significant. Detailed results of these exploratory models are presented in Appendix B.

5. DISCUSSION

The current study aimed to explore the relationship between generative AI (GenAI) dependency and perceived loneliness among international students. Hypothesis 1, which proposed a negative correlation between GenAI dependency and perceived loneliness, was rejected. The results revealed a statistically significant positive correlation between GenAI dependency and loneliness ($r = .455$, $p < .001$), indicating that higher emotional reliance on GenAI tools is associated with increased loneliness. This represents a moderate to strong correlation, suggesting that GenAI dependency explains a meaningful portion of the variation in students' loneliness levels (Cohen, 1988). This association persisted even when controlling for age, gender, and duration abroad in a multiple regression analysis ($\beta = .531$, $p < .001$, $R^2 = .237$). The R^2 value indicates that approximately 24% of the variance in loneliness can be explained by GenAI dependency and demographic variables a large effect by social science standards. Further, ANOVA analyses showed that students highly dependent on GenAI reported significantly greater loneliness compared to those with moderate or low dependency ($F(2, 90) = 9.42$, $p < .001$, $\eta^2 = .173$). An η^2 of .173 reflects a large effect size, indicating that the level of GenAI dependency had a substantial impact on reported loneliness. Hypothesis 2, which posited that students using GenAI primarily for emotional support would report higher loneliness, was also rejected. Emotional motivation for using GenAI did not significantly moderate this relationship ($\beta = 0.017$, $p = .864$), whereas low emotional stability emerged as a substantial predictor of loneliness ($\beta = 1.447$, $p < .001$, partial $R^2 = .224$). This partial R^2 suggests that emotional stability alone accounts for 22% of the variance in loneliness, underscoring it as one of the strongest psychological predictors in the study. Check Appendix C for more hypothesis detail.

These findings suggest that rather than alleviating loneliness, GenAI dependency might reflect deeper emotional vulnerabilities among students, potentially functioning as an indicator of underlying emotional distress. This interpretation resonates strongly with the social displacement hypothesis initially described by Kraut et al. (1998), suggesting that digital interactions, especially when extensive, might replace valuable face-to-face exchanges, thereby unintentionally increasing isolation. Complementing this perspective, Nowland et al. (2018) underscored how digital interactions often lack the essential qualities of emotional depth and authenticity required for genuine interpersonal relationships. Such deficiencies may exacerbate existing emotional struggles, driving emotionally vulnerable individuals further into superficial and isolating digital interactions.

One critical angle to consider is the issue of directionality. Loneliness may not simply result from GenAI dependency, it may also drive it. Individuals experiencing high loneliness may increasingly rely on AI-based tools to fill emotional voids, which could further reduce motivation for real-world social connection, creating a self-reinforcing feedback loop. Cacioppo and Patrick (2008), Kim et al. (2009), and Cacioppo et al. (2010) highlight this "help-seeking spiral," where digital coping can unintentionally perpetuate emotional withdrawal. This underscores the urgent need for longitudinal or diary-based methodologies to determine whether GenAI is a cause or a consequence of loneliness. Without such evidence, interventions risk misdiagnosing the source of students' emotional needs.

Another plausible explanation, though not directly tested, is the culturally neutral nature of GenAI interactions, which may be particularly appealing to international students. Unlike human conversations that might be burdened with language barriers, implicit biases, or cultural misunderstandings, GenAI offers a judgment-free, fluent interaction space. Zheng et al. (2023) and Ward et al. (2001) argue that international students often experience discomfort or exclusion in host cultures, compounded by anxiety over accents, social norms, or unfamiliarity with local idioms. The emotionally neutral, always-available interaction that GenAI offers may serve as a culturally safe space. However, Schwab-Marmitt and Stone (2024) caution that this very comfort may discourage students from engaging in real life social risk taking, such as initiating new friendships, joining clubs, or practicing a second language ultimately deepening isolation.

Yet, the appeal of GenAI masks concrete psychological and structural risks. Bickmore et al. (2018) and Fiske et al. (2019) caution that GenAI lacks true emotional comprehension and cannot form what clinicians call a "therapeutic alliance." This means it may fail to detect crisis cues such as suicidal ideation or self-harm, especially when users subtly hint rather than explicitly state distress. Moreover, GenAI can deliver emotionally inconsistent responses sometimes warm, other times robotic further destabilizing emotionally fragile users. Luxton and Suresh (2023) argue that such emotional mis attunement may aggravate user frustration or feelings of invalidation, particularly among those seeking human like empathy. These risks are not theoretical. As GenAI becomes more integrated into daily academic and emotional life, students may mistake it for a reliable companion, increasing dependence on a tool that was never designed to hold or heal emotional trauma.

The absence of a significant moderation effect from emotional motivation adds nuance to the findings. There are at least two plausible interpretations. First, the emotional motivation item used may have been too simplistic. A single item measure may fail to capture the multifaceted ways users engage with GenAI emotionally. Second, GenAI's current emotional capacities remain limited; even those who seek emotional support may not receive meaningful feedback, minimizing observable differences in outcomes. Studies by Lee and Cho (2022) and Kretzschmar et al. (2021) support this notion, showing that emotional use of technology often brings short-term relief but lacks the relational and emotional scaffolding needed to foster resilience or long-term wellbeing.

A major insight from this study is the prominent role of personality particularly emotional stability as a predictor of loneliness. Low emotional stability, closely linked with neuroticism, emerged as a stronger predictor than any other variable. Individuals scoring low on this trait are more prone to anxiety, emotional volatility, and sensitivity to rejection. Heinrich and Gullone (2006) and Widiger and Oltmanns (2017) explain that emotionally unstable individuals are more reactive to interpersonal stress and may also perceive social situations more negatively, regardless of their actual context. This implies that GenAI use may function differently depending on the psychological profile of the user. Future work should consider testing moderated moderation effects, such as whether the GenAI

and loneliness relationship is amplified among users high in neuroticism or emotional instability.

In terms of real-world applications, the findings suggest universities must avoid treating GenAI as a one size fits all solution to student wellbeing. Instead, a hybrid or blended support model is more appropriate integrating GenAI with human interventions. For example, universities could deploy digital resilience workshops that teach students how to use GenAI critically, peer mentoring programs that supplement AI conversations with real human interaction, or even opt-in dashboards that notify users when they've engaged with GenAI excessively, similar to screen-time alerts. Nowland et al. (2018) and Prizant-Pochat and Hofmann (2025) advocate for such integrated approaches that balance autonomy with accountability.

Finally, the findings raise significant policy and ethical considerations. As GenAI becomes embedded in academic and emotional life, institutional guardrails are essential. The UNESCO AI Ethics Report (2021) calls for minimum transparency standards, such as disclaimers that GenAI is not a therapist. Bickmore et al. (2018) suggest escalation protocols when users express harm-related language, while Hofmann and Kretzschmar (2022) argue for mandatory AI literacy education as part of international student orientation. These practices ensure that students do not mistake GenAI for professional support and are aware of its limitations.'

This study contributes new insight by demonstrating that GenAI dependency may not merely reflect digital overuse but could serve as a proxy for emotional vulnerability particularly among students low in emotional stability. While prior research has focused on general digital tools, this study helps to examine how emotionally motivated interactions with GenAI specifically relate to perceived loneliness. Furthermore, the finding that GenAI does not moderate emotional motivation but is used differently across personality profiles highlights the need to individualize digital support tools rather than treat them as universally beneficial.

In conclusion, this study provides a nuanced understanding of the psychological, cultural, and structural dimensions surrounding GenAI use among international students. The findings suggest that while GenAI may serve as a tool of convenience and cultural comfort, it also risks deepening emotional vulnerability when used in place of real social connection. Loneliness may not only be unalleviated by GenAI but might even be reinforced by it, particularly for those already prone to emotional instability. Therefore, it is essential for educators, developers, and policymakers to adopt a critical and compassionate approach to AI integration, one that blends digital utility with human empathy and institutional care. A more detailed breakdown of each hypothesis result and interpretation is provided in Appendix C.

6. LIMITATIONS

This study investigated the relationship between generative AI (GenAI) dependency and loneliness among international students, focusing on emotional dimensions. Despite valuable insights, several limitations exist. Firstly, while the Digital Attachment to AI (DAI) scale (Morales et al., 2023) was used, only three items directly related to emotional dependency. This highlights a broader gap, as no comprehensive validated scale specifically measures emotional dependency on GenAI, indicating a need for more targeted measurement tools in future research.

Another limitation involves self-report survey methods may have, which can introduce response biases due to subjective interpretations, underreporting loneliness, or overestimating AI engagement.

The sample is restricted to international university students. Cultural contexts, institutional support, and AI tool accessibility could vary significantly across other populations.

Additionally, missing demographic data reduced statistical power and possibly obscured subtle findings, particularly for subgroup analyses.

Lastly, due to the cross-sectional nature of the data, causality cannot be determined. It remains unclear whether GenAI dependency leads to loneliness, loneliness increases GenAI use, or if a separate factor influences both. Longitudinal studies would better clarify these relationships.

7. FUTURE RESEARCH

This study provided foundational insights into generative AI (GenAI) use and loneliness among international students, but further research is essential. A critical next step is creating a validated psychometric scale explicitly designed to measure emotional dependency on GenAI tools. Such a scale should differentiate emotional, cognitive, functional, and behavioural dimensions, facilitating accurate comparisons across AI platforms and user groups.

Another key research direction involves exploring causality through longitudinal studies. These would clarify whether increased GenAI use leads to loneliness or if loneliness prompts greater reliance on GenAI for emotional support, identifying potential cyclical interactions over time.

Future work should also assess mental health outcomes related to various GenAI uses beyond emotional dependence, such as intellectual support, companionship, or anxiety relief. Combining qualitative approaches (interviews, diaries) with quantitative dependency data will reveal the subjective meaning of GenAI interactions and their psychological impact.

Investigating diverse populations, such as domestic students, professionals, and other user groups, will further illuminate moderating factors like cultural background, technological history, and social support networks.

Finally, ethical implications of increasing emotional reliance on GenAI warrant scrutiny. Understanding users' ability to differentiate artificial from human empathy will inform responsible AI design, regulation, and mental health practices.

8. CONCLUSION

This study explored the relationship between generative AI (GenAI) use and loneliness among international students, aiming to understand whether GenAI dependency alleviates or exacerbates loneliness. Using statistical analyses including correlation, ANOVA, and regression, significant findings emerged.

Results confirmed a significant positive correlation between GenAI dependency and loneliness, indicating students experiencing greater social isolation were more emotionally reliant on GenAI tools. Regression analysis confirmed that this relationship persisted even after controlling for age, gender, and duration abroad, highlighting a strong link between AI dependence and social well-being.

Contrary to initial expectations, the findings suggest GenAI use does not mitigate loneliness; instead, it serves as a coping mechanism for students already experiencing emotional isolation. ANOVA further indicated that higher dependency levels might eventually substitute virtual companionship for genuine human connections, aligning with existing literature on digital attachment.

The results have notable theoretical and practical implications. Theoretically, they position GenAI not merely as productivity or learning tools but as significant psychological aids. Practically, these findings urge educational institutions and support services to recognize GenAI dependency as indicative of unmet emotional needs, prompting the integration of human-focused support alongside digital resources.

Future research should focus on developing a psychometrically robust scale tailored specifically for emotional dependency on GenAI, alongside longitudinal studies to clarify causal relationships. Additionally, broadening the research to diverse student and professional populations can reveal how cultural and social contexts influence emotional interactions with GenAI.

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10. APPENDIX

Appendix A: Tertile-Based ANOVA on GenAI Dependency

To explore potential non-linear effects, the continuous dai_total score was divided into three equal-sized groups (n = 31 per group) using the ntile () function from the dplyr package in R. The resulting categorical variable, dai_tertile, was used in a one-way ANOVA to assess whether levels of GenAI dependency were associated with significant differences in loneliness scores.

Table: Tertile Based ANOVA

Gen Ai Dependency Group	n	Mean Loneliness (UCLA)	SD
Low	31	14.58	5.06
Medium	31	13.94	5.62
High	31	19.06	4.46

A one-way ANOVA (aov (ucla_total ~ dai_tertile, data = data)) showed a significant group effect:

- **F (2, 90) = 9.42**, **p < .001**
- **Effect size η^2 = 0.173**, indicating a large effect

Tukey's HSD post-hoc tests revealed that students in the **High Dependency** group had significantly higher loneliness scores than both the Low (p = .002) and Medium (p < .001) groups. No significant difference was found between the Low and Medium groups (p = .87).

To complement the primary analyses where key constructs were treated as continuous variables, tertile-based categorical versions were computed and tested to explore potential non-linear patterns. These robustness checks are reported below.

1. Loneliness Tertiles Participants were divided into three equal-sized groups based on total scores on the UCLA Loneliness Scale:

These categorical groups were used in ANOVA and chi-square tests to verify patterns found in continuous models.

Lonelinesss Group	UCLA Score Range	n
Low	(8 - 12)	31
Medium	(13-17)	31
High	(18-24)	31

2. Emotional Stability Tertiles (TIPI) Emotional stability scores from the TIPI (2-item scale) were categorized as follows:

Stability Group	TIPI Score Range	n
Low	1.0-3.0	32
Medium	3.1-4.5	30
High	4.6-7.0	31

ANOVA was conducted to test for differences in loneliness across these groups. Results showed significantly higher loneliness in the low stability group, consistent with regression findings.

These categorical versions support the patterns observed in the main models and demonstrate the robustness of the analytical approach.

Appendix B: Robustness Checks

To ensure the stability and generalizability of the main findings, several additional robustness checks were conducted using subsample and interaction analyses. These were not central to the hypotheses but serve to explore whether the primary relationships between GenAI dependency and loneliness vary across different student characteristics or usage contexts.

1. Country of Origin Interaction Model

An interaction term between GenAI dependency (DAI total) and respondents' country of origin was tested to assess whether the relationship with loneliness differed between Dutch, EU, and non-EU students. While DAI total remained a significant predictor ($\beta = 0.653$, $p = .0048$), no significant interaction effects were observed. Model $R^2 = 0.255$.

Variable	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	9.2334	1.9089	4.837	5.57E-06
dai_total	0.6527	0.2258	2.89	0.00485
factor(origin)2	3.6807	2.3824	1.545	0.12595
factor(origin)3	-2.6495	3.5519	-0.746	0.45768
dai_total x factor(origin)2	-0.2015	0.2625	-0.768	0.44477
dai_total x factor(origin)3	NA	NA	NA	NA
Multiple R-squared	0.2549			
Adjusted R-squared	0.2211			
F-statistic	F(4,88) = 7.528			

2. Same Country vs Abroad Subsample

A model was estimated including an interaction between DAI total and whether the student was studying in the same country they were born in. No significant interaction effects emerged, and the variable could not be fully estimated due to singularities, suggesting insufficient variation in the sample.

Variable	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	11.0355	1.1136	9.91	3.93E-16
dai_total	0.5574	0.1143	4.878	4.53E-06
different.country	NA	NA	NA	NA
dai_total:different.country	NA	NA	NA	NA
Multiple R-squared		0.2073		
Adjusted R-squared		0.1986		
F-statistic		F(1,91) = 23.8		

3. Emotional Use Subgroup Regression

A subsample analysis was conducted including only those participants who reported using GenAI for emotional support at moderate to high levels (scores ≥ 3 on a 5-point scale). In this subsample (n = 25), DAI total was not a statistically significant predictor of loneliness (β = 0.301, p = .214), suggesting that among emotionally motivated users, the link between dependency and loneliness may be weaker or more complex**.**

Variable	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	15.859	3.3599	4.27	<.001
dai_total	0.3013	0.02355	1.279	2.14E-01
Multiple R-squared		0.06641		
Adjusted R-squared		0.02581		
F-statistic		F(1,23) = 1.636		

4. Emotional Intent Interaction Model

An alternative interaction model was constructed between DAI total and the item "I use AI when I feel lonely or disconnected." While DAI total was again a significant predictor (β = 0.614, p = .004), the interaction term was not statistically significant (β = –0.122, p = .219), indicating that emotional motivation did not moderate the core relationship. Model R^2 = 0.250.

Variable	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	8.13684	2.17498	3.741	0.000324
dai_total	0.61444	0.20626	2.979	0.003727
Ai use when lonely or disconnected	2.93711	1.50752	1.948	0.05453
dai_totalx Ai use when lonely or disconnecte	-0.12197	0.09855	-1.238	0.219099
Mulitiple R-squared		0.2503		
Adjusted R-squared		0.2251		
F-statistic		F(3.89) = 9.9.07		

Appendix C: Variable Description table

Variable	Description
dai_total	Total score from Digital Attachment to AI (DAI) scale (5 items, 1-5 Likert)
ucla_total	Total loneliness score from UCLA short 8 item scale (8 items, 1-4 Likert)
ai.for.emotional.support	Frequency of GenAI use for emotional support (1 = Never, 5 = Very Often)
ai.use.when.lonely.or.disconnect	Binary indicator: GenAI use when lonely/disconnected (1 = Yes, 2 = No)
different_country	Whether participant studies in a country different from birth (1 = Yes, 2 = No)
origin	Country group of origin: 1 = EU, 2 = non-EU, 3 = Netherlands
age	Age group: 1 = 18-21, 2 = 22-25, etc
gender	Gender: 1 = Male, 2 = Female, 3 = Non-binary, 4 = Prefer not to say
duration	Time abroad: 1 = <3mo, 2 = 3-6mo, 3 = 6-12mo, 4 = 1-2y, 5 = >2y
Extraversion	Extraversion trait (average of 2 items)
Agreeableness	Agreeableness trait (average of 2 items)
Conscientiousness	Conscientiousness trait (average of 2 items)
Emotional_Stability	Emotional Stability trait (average of 2 items)
Openness	Openness to experience trait (average of 2 items)

Appendix D: Hypothesis Discussion

Hypothesis 1 Discussion:

Hypothesis I proposed that increased dependency on generative AI tools would be negatively associated with perceived loneliness. However, this hypothesis was rejected. The statistical findings instead demonstrated a significant positive relationship (r = 0.455, p < .001), meaning that as GenAI dependency increases, loneliness also

tends to increase. The regression analysis further supported this, with DAI scores remaining the only significant predictor of loneliness ($B = 0.531$, $p < .001$) even after controlling for age, gender, and duration abroad. These results indicate that GenAI tools are not mitigating loneliness but may instead reflect underlying emotional vulnerability.

This result is consistent with recent work that hypotheses that digital technology, whilst widely accessible and functional, perhaps cannot offer depth of human interaction to reduce loneliness (Nowland et al., 2018; Wiederhold, 2020). Morales et al. (2023) went on to report that individuals who were emotionally needy became attached to AI, and they were more likely to use these technologies to cope with distress rather than reduce it. The results here lend support for this argument, and we would theorize that GenAI's probable role could be compensatory and not curative.

It might be that lonelier individuals are more likely to seek GenAI interaction and therefore reverse the causal assumption. Instead of GenAI decreasing loneliness, loneliness might cause GenAI dependency. This difference matters, for it has implications for designing and implementing GenAI instruments in mental support and well-being services. The non significance for age, gender, and duration abroad again accentuates psychological, not demographic, origins for this relationship.

Hypothesis 2 Discussion

Hypothesis II postulated that international students scoring higher for loneliness would also score higher for GenAI dependency for emotional support, expecting a moderation or interaction effect. Although we did note a general correlation between GenAI use and loneliness, a specific interaction between DAI scores and frequency of emotional use (centerd) did not emerge as significant ($p = 0.864$). Hypothesis II is therefore partly supported: lonely students seem to utilize GenAI more, but dependency of emotional use neither reinforced nor modified this link.

These findings are consistent with the idea of passive coping strategies. Studies by Lee and Cho (2022) and Kretzschmar et al. (2021) show that emotionally driven technology use often provides short-term comfort but lacks the relational depth to reduce loneliness meaningfully. In our study, the emotional support item showed a mean of 1.87 (on a 5-point scale), indicating that most respondents did not actively use GenAI for emotional relief, even if a subgroup of highly lonely students did. This could suggest either a general lack of trust in AI's emotional capabilities or the presence of alternative coping strategies.

Importantly, this highlights the nuanced role of AI in students' lives. Emotional reliance on GenAI is not uniform and may not be consciously acknowledged by all users. This subtlety could explain the non-significant interaction effect: even if loneliness predicts greater GenAI use, emotional reliance is not necessarily a distinct or intensified behavior among the loneliest students. Future studies could benefit from a mixed-methods approach to better understand how students interpret and emotionally relate to AI in their daily lives.