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Research Article

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Social Loneliness in Youth: A BERT-based Sentiment Analysis of Digital Texts

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Abstract

Background: Digital platforms profoundly shape how young individuals form and maintain social connections. While these platforms can enhance social engagement, they may also intensify feelings of social loneliness, particularly among youth navigating identity and peer relationships.

Objective: This study aims to explore the emotional dimensions of young adults' digital experiences by using Natural Language Processing (NLP)-based sentiment analysis, focusing on the manifestation of social loneliness in online discourse.

Methods: Textual data were collected through semi-structured interviews with 300 university students (ages 18–25) in Turkey regarding their digital platform usage. Sentiment classification was conducted using two models: a baseline Naive Bayes algorithm with TF-IDF vectorization and a BERT-based deep learning model (BERTurk). The models were evaluated based on accuracy, precision, recall and F1-score.

Results: Findings revealed that 40% of participants expressed positive sentiment, 35% negative and 25% neutral regarding digital platform use. The BERT model significantly outperformed Naive Bayes in all performance metrics (F1-score ≈ 0.75), particularly in identifying negative emotional content. Qualitative themes highlighted a dual impact of digital media, serving both as a source of connection and emotional detachment.

Conclusion: Context-sensitive deep learning models provide valuable insights into youth's digital social experiences. This research emphasizes the potential of AI-driven sentiment analysis to uncover psychosocial dynamics like social loneliness and offers implications for digital mental health interventions targeting young populations.

Keywords: Social loneliness; Digital platforms; Youth; Sentiment analysis; Natural language processing; BERT

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Introduction

Digital platforms have transformed the ways individuals interact, socialize and engage in everyday activities. Social media, online forums, gaming environments and educational tools are increasingly integrated into the daily lives of young adults, influencing their social interactions and emotional well-being. While these platforms provide opportunities for communication and community building, they can also lead to unintended consequences such as superficial relationships, social comparison and emotional detachment.

Social loneliness refers to a perceived state of isolation that occurs when an individual's social relationships, in terms of their quantity or quality, fall short of personal expectations. Young adults, who are in a transitional life stage involving identity formation and peer affiliation, may

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be especially vulnerable to such effects. In digital environments, the curated portrayal of ideal lives and constant exposure to others' experiences can intensify feelings of inadequacy and disconnection.

This study aims to investigate how young adults experience social loneliness through their engagement with digital platforms, using advanced Natural Language Processing (NLP) techniques to analyze their verbal expressions. In particular, we compare the performance of traditional machine learning and deep learning models in classifying sentiments related to digital experiences. By doing so, the study contributes to understanding the emotional dynamics of digital life and offers methodological insights into the use of AI in behavioral research.

Background and Related Work

Social loneliness is defined as the subjective sense of isolation stemming from a perceived inadequacy in the quantity and quality of one's social relationships [1]. It encompasses both emotional and cognitive components and is particularly salient among young adults who are in a critical developmental stage involving identity formation and a heightened need for social belonging [2]. Hawkley and Cacioppo emphasize the detrimental effects of loneliness on both mental and physical health, underlining its importance in behavioral and psychological research [3].

Digital platforms while offering unprecedented opportunities for communication and connection often produce paradoxical outcomes. On one hand they can enhance social capital by facilitating connections; on the other, they may reinforce feelings of social inadequacy and isolation due to superficial interactions and the curated exposure to idealized versions of others' lives [4-6]. This contradiction is often conceptualized as the loneliness paradox, where increased digital connectivity does not always equate to deeper emotional fulfillment [7].

Weiss (1973) proposed a two-dimensional model of loneliness, distinguishing between emotional loneliness (stemming from the absence of close, intimate attachments such as a partner or family member) and social loneliness (arising from the lack of a broader social network or sense of community). In the context of this study, many young adults reported experiencing social loneliness despite having numerous digital contacts suggesting that quantity does not compensate for the lack of emotionally meaningful connections.

This aligns with Baumeister and Leary's (1995) need to belong theory, which posits that humans have a fundamental psychological drive to form and maintain enduring, positive and significant interpersonal relationships. When digital interactions fail to meet this intrinsic need due to their often-fragmented or performative nature individuals may experience emotional dissatisfaction, which becomes linguistically evident in their online expressions.

In this study, such emotional patterns are made measurable through sentiment analysis, a subfield of Natural Language Processing (NLP) that detects affective states in text. While earlier models like Naive Bayes relied on statistical probabilities without contextual understanding, advanced deep learning models such as BERT provide contextualized semantic interpretation [8,9]. Specifically, BERTurk, optimized for Turkish's morphologically rich structure, enables nuanced classification of sentiment [10]. Empirical findings from this research reveal that negative sentiments often reflective of unmet social and emotional needs are especially well-captured by these models, reinforcing the theoretical alignment between expressed language and underlying psychological states.

Methods

Study design

This research adopted a descriptive and comparative quantitative design, focusing on text-based sentiment patterns among young adults. Text data were collected from semi-structured interviews and processed through natural language processing techniques to identify emotional tones related to social loneliness.

Ethical approval

The study was conducted following ethical standards and approved by the Ethics Committee of Van Yüzüncü Yıl University, Faculty of Social and Human Sciences (Approval No: 2024/22-21). Participation was voluntary and data were anonymized to maintain confidentiality and privacy.

Participants

The sample consisted of 300 undergraduate students aged 18 to 25 years from various departments of Van Yüzüncü Yıl University in Turkey. Participants were selected using purposive sampling, with prior experience using digital platforms as the primary criterion.

Data collection

Data were collected through face-to-face interviews using a semi-structured form. Participants were asked open-ended questions about their digital platform use, emotional experiences and perceptions of social connections. Example questions included: What purposes do you use digital platforms for?; How do these platforms affect your social interactions?; and Do you feel more socially isolated after using digital platforms?

Data labeling and preprocessing

Text data were manually labeled into three sentiment categories: Positive, negative and neutral. Two

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independent NLP experts performed the labeling and inter-coder reliability was high (Cohen's *Kappa*>0.80). Preprocessing included lowercasing, punctuation and stopword removal, tokenization (WordPiece) and vectorization (TF-IDF for Naive Bayes; contextual embeddings for BERT).

Sentiment classification models

- **Naive bayes:** A baseline probabilistic classifier was trained using TF-IDF features to predict sentiment categories.
- **BERT:** A transformer-based contextual classifier (BERTurk) was implemented with the following hyperparameters: Learning rate=2e-5, epochs=4, batch size=16, max sequence length=128.

Evaluation metrics

Both models were evaluated using accuracy, precision, recall and F1-score. These metrics were computed separately for each sentiment class (positive, negative and neutral).

Computational environment

The analysis were conducted in Python 3.10 using the following libraries: Pandas, NumPy, scikit-learn, HuggingFace Transformers, NLTK and spaCy. Model training and testing were performed using a system with an Intel Core i7-12700H CPU, 32 GB RAM and NVIDIA RTX 3060 GPU on Google Colab.

Results

The analysis consisted of both qualitative and quantitative evaluations of sentiment expressed in the collected texts.

Qualitative finding

Thematic analysis of participant responses yielded three dominant sentiment themes:

- **Positive impact:** Several participants reported that digital platforms helped them connect with others and expand their social circles. Examples included making international friends and facilitating group communication during academic tasks.
- **Negative impact:** A significant portion of participants described feelings of loneliness, superficial social interactions and increased social comparison. Statements such as 'everyone on Instagram looks perfect, I feel bad about myself' were common.
- **Neutral reactions:** Some respondents viewed digital platforms merely as entertainment, with minimal influence on their emotional state or social life.

Quantitative findings

Sentiment distribution across the dataset was as follows:

- Positive: 40%
- Negative: 35%
- Neutral: 25%.

Model performance comparison

Two sentiment classification models were evaluated using standard performance metrics. The BERT model significantly outperformed the Naive Bayes classifier **(Tables 1 and 2)**.

Table 1: Naive Bayes performance.

Sentiment class	Precision	Recall	F1-Score
Positive	0.32	0.31	0.31
Negative	0.29	0.3	0.29
Neutral	0.28	0.3	0.29

Table 2: BERT performance (BERTurk).

Sentiment class	Precision	Recall	F1-score
Positive	0.76	0.75	0.75
Negative	0.77	0.75	0.76
Neutral	0.75	0.76	0.76

The BERT model's ability to accurately identify negative sentiment was especially notable, indicating its strength in analyzing emotionally nuanced content related to social loneliness.

Discussion

This study aimed to explore the relationship between digital platform usage and social loneliness among young adults using NLP-based sentiment analysis. The findings demonstrated a nuanced emotional landscape, where digital platforms serve both as tools for connection and as triggers for emotional isolation.

Qualitative findings revealed that while some individuals use digital media to strengthen existing relationships or form new ones, others experience intensified feelings of disconnection and inadequacy. This duality aligns with the 'loneliness paradox' found in prior research, where increased online interaction does not always correspond to deeper emotional fulfillment [5,7]. Statements reflecting social comparison and superficial connections were especially common among those with negative sentiment, supporting theories that link digital exposure to diminished self-worth.

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Quantitative results further validated these insights by demonstrating the effectiveness of deep learning models especially BERT in detecting subtle emotional cues in user-generated text. The superior performance of BERT compared to Naive Bayes is consistent with existing studies that emphasize the benefits of contextual embeddings in sentiment analysis [9,10].

Notably, the model was particularly adept at identifying negative sentiments, a critical factor when studying emotionally sensitive constructs like loneliness. This underscores the value of AI and NLP techniques in behavioral research, offering scalable methods to detect psychosocial risk indicators in digital communication. Moreover, the study contributes methodologically by showing how linguistically rich and morphologically complex languages such as Turkish can benefit from tailored NLP models like BERTurk.

In sum, these findings point to the dual nature of digital environments both enabling and undermining social connectedness. Understanding this complexity is vital for educators, clinicians and technology developers aiming to foster digital well-being among young users.

Conclusion and Future Work

The study findings indicate that the use of digital platforms simultaneously triggers both feelings of connection and disconnection among young adults. This dual effect aligns with what the literature refers to as the loneliness paradox [5,7]. It is consistent with studies suggesting that increased time spent on social media often correlates with heightened feelings of [6,11]. On the other hand, some participants reported expanding their social circles through digital platforms, which aligns with findings by Ellison et al. [4]. This suggests that digital experiences do not produce a one-dimensional impact but rather vary across individuals.

Participants' descriptions of digital environments as fake, superficial or unreciprocated and their expressions of feeling more lonely, excluded or inadequate, correspond to Weiss's concept of social loneliness. This form of loneliness stems not from the quantity but from the perceived quality of social bonds. Furthermore, mentions of a lack of genuine friendship or absence of emotional sharing" indicate the presence of emotional loneliness. These observations underscore the multidimensional nature of loneliness and how digital experiences can influence these dimensions.

The study highlights that digital loneliness is not merely a function of time spent online but is closely tied to perceived relationship quality and emotional fulfillment. Notably, the BERT model's high performance in classifying negative sentiment suggests that digital loneliness manifests clearly in language. This points to the potential of AI-driven sentiment analysis to identify at-risk youth experiencing digital loneliness. Additionally, the study reveals that digital platforms can be both beneficial and detrimental, offering new insights for technology design and digital psychological counseling practices.

This work contributes to interdisciplinary efforts in digital mental health research by providing an AI-driven framework for analyzing social emotions in online communication. By demonstrating high classification accuracy for negative sentiment, our model also offers implications for early detection of psychosocial vulnerabilities in digital environments.

Future work

Incorporate standardized psychological instruments (*e.g.,* UCLA Loneliness Scale) to validate textual sentiment classifications. Expand the participant pool to include diverse age groups and socio-cultural backgrounds. Apply time-series sentiment tracking to evaluate long-term emotional shifts in digital interactions. Integrate multimodal data (text, emojis, interaction logs) for a richer understanding of digital social behavior. Explore real-time sentiment detection systems as part of preventive digital mental health tools for youth.

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Conflict of Interest

The author declares no conflict of interest.

Ethical Approval

This study was reviewed and approved by the Ethics Committee of Van Yüzüncü Yıl University, Faculty of Social and Human Sciences (Approval No: 2024/22-21). All participants provided informed consent and the research was conducted in compliance with the Declaration of Helsinki.

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