

Development and Application of an Emotion Analysis Agent — A Prototype Study on Multi-Group Emotional State Assessment and Guidance

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Abstract

In the digital age, public emotional health has become a prominent concern, with significant differences across population groups, highlighting the need for scientifically grounded and adaptable intelligent support tools. This study developed an emotion analysis agent capable of assessing emotional states across multiple groups and providing preliminary guidance recommendations. Through systematic literature review integrating emotional psychology and affective computing, we proposed a theoretical framework for multi-group emotional state assessment and guidance. Based on this framework, we designed a questionnaire combining self-developed items on emotional factors with standardized clinical scales (GAD-7, BDI-II) and surveyed 79 respondents spanning adolescents, adults, and the elderly. Data analysis revealed two main findings: emotional resources increased with age, with older adults scoring highest across all dimensions; and although average scores fell within normal ranges, over half of respondents reported intermittent mild anxiety, indicating widespread subclinical distress. Guided by the framework and data, we implemented a rule-based agent prototype, demonstrating the technical feasibility of an assessment-guidance closed loop. This study bridges psychological theory and computational modeling, demonstrates a replicable undergraduate-level research path, and provides a prototype foundation for developing accessible, age-sensitive digital mental health tools.

Keywords

emotion analysis agent, multi-group assessment, emotional state evaluation, questionnaire development, age differences, AI application

1. Introduction

1.1 Research Background

Mental health has become a global public health concern in the digital era. Rapid socio-economic and technological development has significantly improved living standards, yet individuals are experiencing heightened anxiety and stress in fast-paced, highly competitive modern societies. Emotional issues have thus emerged as a core factor affecting quality of life. Different population groups face distinct challenges: adolescents contend with academic competition and social pressure, often expressing negative emotions through subtle online channels; working professionals, constrained by workplace norms and life pressures, tend to conceal their true emotions, leaving them with limited avenues for emotional support; and older adults, affected by the digital divide, struggle to convey their emotional needs through smart devices. Furthermore, current standardized psychological services often overlook significant individual differences in emotional expression and coping strategies. Consequently, emotional health has transformed from a private issue into a public concern affecting social well-being.

How to scientifically identify and accurately respond to the emotional needs of different groups, and subsequently provide personalized emotion regulation solutions, has become a pressing practical problem. This study addresses the dual challenge of universal and group-specific emotional health issues while leveraging the empowering potential of digital and AI technologies. Guided by relevant theories, we integrate emerging technologies to construct an emotion analysis agent capable of identifying, understanding, and responding to the specific needs of diverse groups, thereby contributing to the growing public mental health challenge.

1.2 Research Questions and Objectives

The core research question of this study is: How can an agent model be constructed to scientifically assess the emotional states of multiple groups and match them with preliminary guidance recommendations? To address this overarching question, we pursued four interconnected objectives. First, through systematic literature review, we aimed to establish a theoretical framework and identify core dimensions for emotional state assessment. Second, building on this framework, we sought to develop and validate a questionnaire capable of capturing group-specific emotional characteristics. Third, using the collected data, we aimed to implement a prototype agent that could classify users' emotional states and generate personalized guidance suggestions. Fourth, we sought to evaluate the prototype's effectiveness and examine the ethical boundaries of its application.

1.3 Contributions of This Study

This study makes three main contributions to the field. Theoretically, it bridges emotional psychology and AI computational modeling by translating age-specific emotion regulation patterns into a rule-based assessment-guidance framework, addressing the gap between psychological theory and technical implementation. Methodologically, it demonstrates a design science research path from theoretical construction to prototype validation, offering a replicable template for undergraduate-level AI-psychology interdisciplinary projects. Practically, the prototype provides a proof-of-concept for low-cost, scalable digital emotional support tools that can be adapted to different age groups, potentially reaching populations with limited access to traditional mental health services.

2. Literature Review and Theoretical Framework

The complex regulatory mechanisms of human emotion, diverse intervention methods, and evolving assessment technologies have consistently attracted interdisciplinary research interest. This study collected and organized over 50 authoritative research articles on emotion from the past five years, presenting a knowledge map ranging from fundamental theories of emotion to computational recognition, age-specific regulation patterns, and intervention methods. This formed a theoretical framework providing support for developing a multi-group emotional state assessment and guidance agent.

2.1 Emotion Theories and Classification Systems

Early discrete emotion theories sought to define a limited set of basic emotions. Ekman's model of six basic emotions gained wide influence due to cross-cultural empirical support [1]. Plutchik's subsequent theory of eight basic emotions expanded upon this by adding categories like trust and anticipation [2]. Such frameworks are intuitive but have limitations in capturing complex or subtle emotional states.

Dimensional theories emphasizing continuity have therefore become mainstream, proposing that core dimensions such as valence, arousal, and dominance can characterize all emotional states. For instance, in driving risk research, the combination of low valence and high arousal emotions correlated with the highest risk levels [3]. Dimensional models provide a flexible theoretical basis for quantitative emotion assessment. The development of tools like the CORE Test, which measures emotions based on thematic cognitive content, represents a direction combining categorization and understanding [4]. This theoretical evolution reflects deepening academic understanding of emotional complexity and provides a more scientific framework for computational modeling.

2.2 Advances in Emotion Recognition Technology

Emotion recognition technology, driven by AI and affective computing, is progressing toward multimodal fusion and deep intelligence. In physiological signal analysis, traditional research relied on manually extracting features from EEG signals [5]. Recent studies demonstrate high classification accuracy using convolutional neural networks for automatic feature extraction [6]. fMRI studies continue to provide evidence for the neural basis of basic emotions, revealing associations between specific emotions and activation of brain regions such as the amygdala and prefrontal cortex [1].

Analysis techniques based on behavior and appearance are also expanding. Analysis of drawing features can translate visual elements like color and saturation into emotional predictors [7]. Analysis of driving behavior has clarified links between discrete emotions like anger and fear and specific risky operations [3]. In text analysis, multi-label classification methods based on pre-trained language models offer approaches for handling complex emotions in social media text [8]. The classic Ekman framework still demonstrates utility in cross-cultural text analysis [2]. More complex models like improved Transformer architectures are being explored for mental health diagnosis [9], indicating a trend toward higher integration in assessment technologies. These findings informed the technical approach for our agent's classification capabilities.

2.3 Age Differences in Emotion Regulation

A substantial body of research reveals systematic evolution of emotion regulation ability with age. Adolescence is viewed as a period of rapid construction for emotion regulation. Although individuals at this stage possess high neuroplasticity, their regulation strategies are still being differentiated and explored [10]. Emotional problems in adolescents often exhibit clear specificity, with internalizing problems linked to cognitive strategies like rumination and externalizing problems associated with behavioral strategies like venting [11]. A clinical study on adolescents with personality disorders revealed the complexity of emotion regulation mechanisms under severe pathological conditions [12].

In middle adulthood, emotion regulation functions tend to mature and optimize. Large-scale cross-national surveys confirm that high-frequency social participation is a key protective factor for emotional health during this stage [13]. Neuroimaging studies show a positive correlation between frontal-limbic system connectivity and behavioral performance in emotion regulation, suggesting cognitive control may

reach an optimal state during this period [14]. However, middle-aged adults face unique social role pressures, and specific negative emotions in parents can now be quantified using specialized scales.

In old age, emotion regulation shifts toward optimization and adaptation. Research indicates that older adults tend to use more stable and simplified strategies, with strategy variability negatively correlated with subjective well-being [15]. Neurobiological mechanisms reveal compensatory phenomena, such as the prefrontal cortex compensating for reduced activation in specific regions through functional generalization [14]. However, old age is accompanied by higher risk of social isolation, with loneliness strongly correlated with negative emotions [13]. These findings directly informed the design of our questionnaire's age-sensitive dimensions.

2.4 Psychotherapeutic Methods for Emotional Support

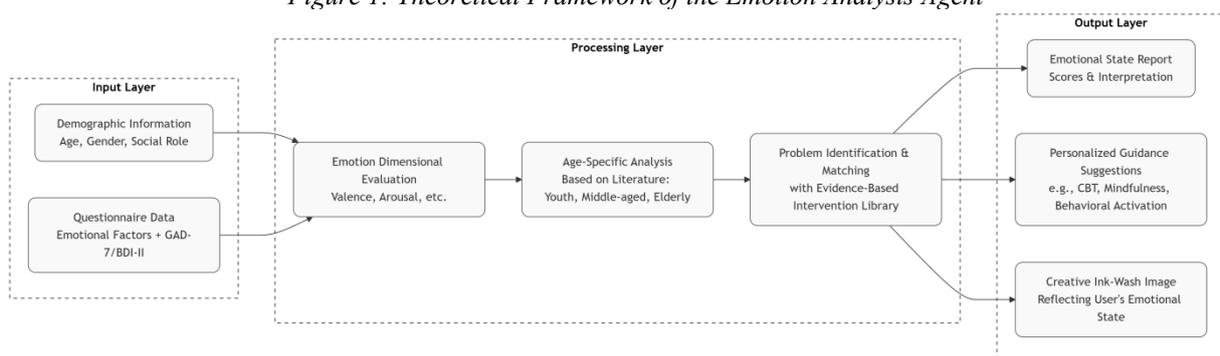
Several evidence-based psychotherapeutic methods have been developed for emotional and behavioral disorders. Cognitive Behavioral Therapy operates by modifying maladaptive cognitions to break the cycle of emotional distress [16]. Behavioral Activation focuses on systematically increasing engagement in positive activities to counteract avoidance cycles in depression, and due to its simplified process, it is considered suitable for resource-limited settings [17].

Mindfulness-Based Therapies and Acceptance and Commitment Therapy represent the third wave of CBT. The former emphasizes cultivating non-judgmental awareness of present-moment experiences to reduce emotional rumination [18]. The latter focuses on accepting distress rather than eliminating symptoms, enhancing psychological flexibility through cognitive defusion and values-guided action [19]. Progressive Muscle Relaxation concentrates on directly alleviating somatic symptoms of anxiety from the physiological arousal level [20]. These methods have different emphases and can be selected or integrated based on an individual's presenting issues, providing the foundation for our agent's guidance suggestions.

2.5 Theoretical Framework of This Study

Based on the literature reviewed above, we developed a conceptual framework to guide the design of the questionnaire and the subsequent agent prototype. The framework integrates four core dimensions that emerged from the literature: **Social Connection and Support** (from studies on social participation and loneliness [13, 21, 22]), **Emotion Regulation Strategies** (from age-specific regulation research [11, 12, 14, 15, 23]), **Specific Stressors and Cognitions** (from developmental stage research [24-31]), and **Self-Perception and Acceptance** (from psychotherapeutic methods [16-20]). These dimensions collectively capture the key factors influencing emotional states across different age groups.

Figure 1: Theoretical Framework of the Emotion Analysis Agent



As shown in Figure 1, the framework follows a three-layer structure. **The input layer** collects demographic data and questionnaire responses covering the four dimensions, plus standardized GAD-7 and BDI-II scores. **The processing layer** applies rule-based logic informed by the literature: it evaluates emotional patterns using dimensional theories, adjusts interpretations based on age-specific findings, and matches problems with evidence-based intervention strategies. **The output layer** generates a personalized report with emotional state summary and tailored guidance—for instance, recommending cognitive

restructuring and mindfulness for a middle-aged user experiencing work-family conflict and high anxiety, rather than academic stress interventions designed for adolescents.

This framework translates theoretical insights into operational logic, ensuring the agent's assessment and guidance are scientifically grounded and developmentally sensitive.

3. Methods

3.1 Overall Research Approach

To achieve the research objectives, we first constructed a theoretical framework through literature review. Second, based on this framework, we developed and validated an emotional assessment questionnaire. Third, using the questionnaire data, we built an emotion classification model and suggestion database, developing an interactive agent prototype. Finally, we evaluated the prototype's effectiveness and ethical implications.

Methodologically, this study followed the design science research paradigm, employing the design-development-evaluation-iteration path. Mixed methods were integrated to enhance scientific rigor: qualitative methods such as literature analysis were used in theory construction, while quantitative methods such as statistical analysis and machine learning were used in data collection and validation.

3.2 Questionnaire Development

3.2.1 Dimension Establishment and Item Generation

Based on the theoretical framework, we developed a questionnaire comprising four sections. **The first section** collected demographic information including gender, age group, social role, and primary sources of life stress. The age groups were defined as youth (12–25 years), middle-aged (26–58 years), and elderly (59 years and above). The cutoff of 58 years was informed by prior neuroimaging research on emotion regulation across the lifespan [14], while the upper limit of youth reflects the typical age range for brain maturation commonly used in developmental studies.

The second section assessed factors influencing emotional states across four dimensions derived from the theoretical framework: **Social Connection and Support** (3 items), **Emotion Regulation Strategies** (4 items), **Specific Stressors and Cognitions** (4 items), and **Self-Perception and Acceptance** (2 items). All items used a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree).

The third and fourth sections incorporated two standardized clinical scales to evaluate emotional symptoms. The Generalized Anxiety Disorder scale (GAD-7) measures anxiety symptoms over the past two weeks with seven items scored from 0 to 3. The Beck Depression Inventory-II (BDI-II) assesses depressive symptoms with 21 items, each scored 0 to 3.

3.2.2 Pre-test and Revision

After initial drafting, a small-scale pre-test was conducted with 15 participants to examine item clarity and estimate completion time. Participants reported that the questionnaire was generally easy to understand, with an average completion time of about 10 minutes. Based on ambiguities identified during the pre-test, instructions for some items were fine-tuned to ensure consistent understanding.

3.2.3 Reliability and Validity

Internal consistency reliability was assessed using Cronbach's α coefficient. The 13-item emotional influencing factors section demonstrated excellent overall reliability ($\alpha = .941$). Subscale reliability coefficients were .757 for **Social Connection and Support** (3 items), .875 for **Emotion Regulation Strategies** (4 items), .864 for **Specific Stressors and Cognitions** (4 items), and .859 for **Self-Perception and Acceptance** (2 items), all exceeding the acceptable threshold of .70.

For validity, content validity was established through a comprehensive literature review and pre-test feedback. Construct validity was examined using item-total correlations, with all coefficients exceeding 0.50 and reaching statistical significance at the 0.01 level, confirming that the questionnaire structure aligned with the theoretical framework.

3.3 Data Collection

3.3.1 Sampling Method and Data Cleaning

This study employed online convenience sampling and snowball sampling for data collection. The questionnaire was created on the Sojump platform and distributed via research team members' WeChat.

After data collection, responses with completion times under two minutes or showing obvious regularity (e.g., selecting the same option for all items) were excluded. Raw data were exported in Excel format, categorical variables were numerically coded, and section scores were calculated for subsequent analysis.

3.3.2 Participants

Data collection was conducted from February 3 to 4, 2026, yielding 79 valid questionnaires. All returned questionnaires were complete and met the inclusion criteria. The sample consisted of 51 females (64.56%) and 28 males (35.44%). Age distribution covered three target groups: 29 youths aged 12–25 years (36.71%), 38 middle-aged adults aged 26–58 years (48.10%), and 12 elderly adults aged 59 years and above (15.19%). In terms of social roles, employed workers accounted for 40.51% and students for 36.71% of the sample.

Geographically, participants were predominantly from Shandong Province (45.6%), followed by Xinjiang Uygur Autonomous Region (11.4%). Smaller numbers came from Guangdong, Liaoning, and Chongqing (6.3% each), and six respondents (7.6%) were located overseas (Singapore). The remaining participants were distributed across eight other provinces. Given the use of convenience sampling, the sample is geographically concentrated and may not be fully representative of the national population.

3.4 Agent Development

3.4.1 Core Model Selection

The Depression/Anxiety Detection and Adjustment Agent utilizes the Doubao 1.5 Pro large model, incorporates an image generation plugin, and loads relevant psychological literature as a knowledge base. It detects users' depression or anxiety indices and classifies them according to specific scores. For populations tending toward depression or anxiety, the BDI and GAD item banks are used respectively. For users with different emotional types, the agent screens the knowledge base to provide targeted advice while generating a creative ink-wash style image related to the user's emotional state. Additional features include providing a psychological crisis hotline when users select negative options in questions related to suicidal ideation, and providing targeted summaries after each response.

3.4.2 Training and Debugging

The agent's persona was built as a warm yet rigorous professional psychological assessment guide skilled in using the BDI-II and GAD-7 scales. The response framework divided interaction into stages: opening remarks, interactive introduction, emotion type classification, question-and-answer, and report and image generation. Through multiple rounds of modification, basic functions were ensured. Results from the survey questionnaire were used to train the agent for general user data handling. An assessment webpage with the same questions was designed using HTML, and users could jump to the agent after completing the test by copying and pasting a generated link.

3.5 Prototype Design

Users interact with the webpage by clicking option buttons. The webpage frontend records selections and generates a link. Users copy this link into the agent's dialogue box to directly generate the analysis report. The interface features a white background with blue-toned buttons that highlight on mouse hover. Upon completion, users can copy the answer link with one click and access functions including Re-take Assessment and View Link. When the agent receives a webpage link, it skips the Q&A session and directly generates the analysis report.

3.6 Ethical Considerations

Protecting participant privacy was a core ethical principle throughout this study. During data collection, anonymous questionnaires were used, and no personally identifiable information was collected. All respondents were clearly informed about the purpose and scope of data usage and provided informed consent prior to participation. Collected data were encrypted and stored on a secure local server with access restricted to the research team, and were used exclusively for the purposes of this study.

The emotion analysis agent prototype is designed to provide algorithm-based preliminary assessment and self-help guidance only. It is not a professional diagnostic or treatment tool, and its suggestions cannot replace consultation with qualified mental health practitioners. This limitation is clearly stated on the interactive interface and in all related documentation. Users are explicitly informed that the agent is intended for emotional self-awareness and initial guidance, and those experiencing severe distress are directed to seek professional help.

4. Results

4.1 Sample Characteristics

The final sample comprised 79 respondents, with 64.56% female and 35.44% male. Age distribution covered the three target groups, with the largest proportion being middle-aged adults (48.10%), followed by youths (36.71%) and elderly adults (15.19%). In terms of social roles, employed workers constituted 40.51% and students 36.71% of the sample.

4.2 Age Differences in Emotional Factors

Regarding primary sources of energy drain, work or academic pressure was the most frequently reported (64.56%), followed by physical health (26.58%), with family responsibilities and interpersonal relationships both cited by 24.05% of respondents. On the four assessment dimensions, sample average scores ranged from 3.39 to 4.15, indicating moderate-to-above average emotional resources.

Inter-group comparisons revealed a clear developmental pattern. As shown in Figure 2, the elderly group scored highest on all four dimensions: Social Connection and Support (4.11), Emotion Regulation Strategies (4.04), Specific Stressors and Cognitions (4.33), and Self-Perception and Acceptance (4.12). The middle-aged group scored in the middle (3.81, 3.74, 4.05, and 4.08 respectively). The youth group scored lowest across all dimensions (3.66, 3.57, 3.71, and 3.74 respectively), with particularly low scores on Emotion Regulation Strategies and Specific Stressors and Cognitions, suggesting this group may be a key focus for intervention.

Gender differences were less pronounced. Females scored slightly higher than males in Emotion Regulation Strategies (3.74 vs. 3.69) and Social Connection and Support (3.89 vs. 3.63). Scores were nearly identical on Specific Stressors and Cognitions (both 3.97) and Self-Perception and Acceptance (both 3.96).

4.3 Prevalence of Anxiety and Depressive Symptoms

Figure 3 shows the mean scores and standard deviations for BDI-II (depression) and GAD-7 (anxiety) by age and gender. According to the scoring standards (BDI-II 21-84 method: 21-34 = no depression; GAD-7: 7-11 = no significant anxiety), all subgroups scored within the normal range on average.

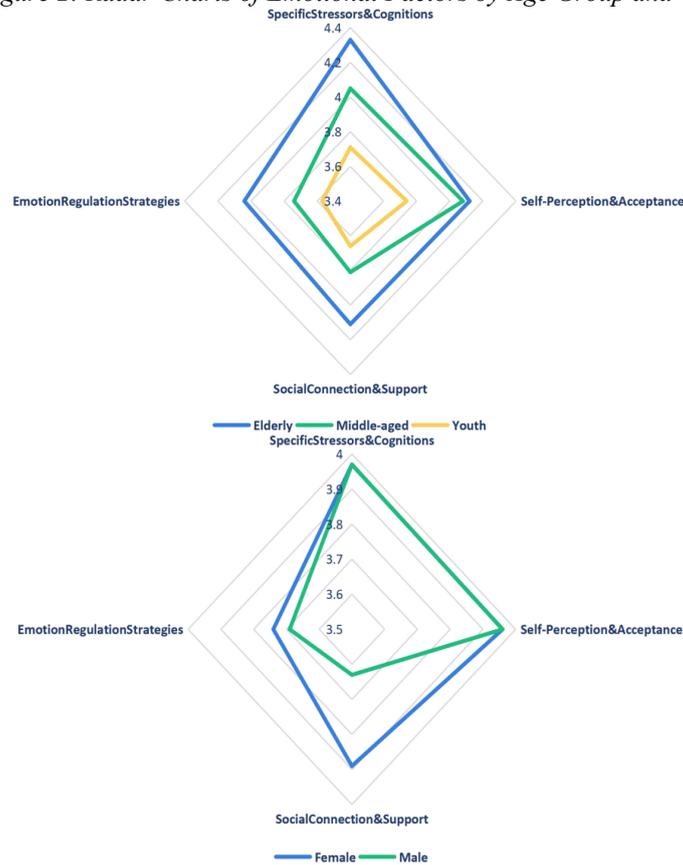
For depression, mean BDI-II scores ranged from 28.82 to 31.67 across groups. Middle-aged females scored highest (31.57, SD = 7.21), while young males scored lowest (28.82, SD = 5.60). For anxiety, mean GAD-7 scores ranged from 10.70 to 12.67. Elderly males scored highest (12.67, SD = 1.53), slightly above the normal threshold, but this group had only three participants. Middle-aged females scored lowest (10.70, SD = 3.71).

Although average scores were within normal limits, item-level analysis showed that many respondents experienced mild anxiety symptoms. Over half (55.7%) reported feeling nervous or anxious for several days in the past two weeks, and nearly half (49.37%) said they could not stop worrying. These figures suggest that

sub-threshold anxiety is common in this sample. In contrast, over 70% reported no depressive symptoms on core BDI-II items like sadness.

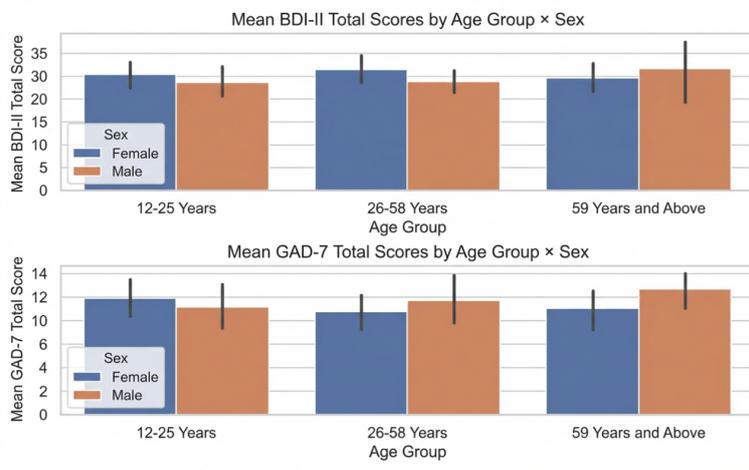
Interestingly, these results do not fully match the age trend found in Section 4.2, where older adults scored highest on positive emotional factors. This suggests that while older individuals may have better emotion regulation strategies, they can still experience depressive or anxiety symptoms, possibly due to health or social stressors. Young females also showed relatively high anxiety scores (11.89, SD = 3.53), which may reflect academic and social pressures.

Figure 2: Radar Charts of Emotional Factors by Age Group and Gender



Note: (Above) Age differences; (Below) Gender differences.

Figure 3: Depression and Anxiety Scores by Age Group and Gender



Note: (Above) Depression scores; (Below) Anxiety scores.

4.4 Agent Prototype Performance

The agent prototype operates by matching assessment results with a structured suggestion database. In preliminary runs, the model automatically output guidance suggestions based on input questionnaire data. For example, a high GAD-7 score paired with a low score in Emotion Regulation Strategies triggered suggestions including mindfulness breathing exercises and introduction to cognitive reappraisal methods. For the middle-aged user group, the suggestion database emphasized work-life balance strategies. For young users, suggestions focused on academic stress management and social skills. This preliminary matching, based on rules and group labels, validated the technical feasibility of the assessment-guidance closed loop.

However, the current agent relies entirely on text-based instructions and lacks workflow stability, making it difficult to adapt to complex environments. Additionally, due to server limitations, the webpage does not have a PHP backend, making security and privacy difficult to guarantee.

5. Discussion

5.1 Interpretation of Key Findings

The finding that emotional resources increase with age aligns with literature conclusions regarding continuous development and optimization of emotion regulation ability in adulthood. The elderly group's highest scores across all dimensions likely reflect psychological maturity and enhanced adaptability gained through life experience accumulation. This supports the optimization and adaptation pattern described in the literature, where older adults use more stable strategies and demonstrate compensatory neural mechanisms.

Conversely, the youth group's relatively lower scores, particularly in emotion regulation strategies and stress management, indicate that adolescence remains a critical period for emotion regulation capacity building. This finding is consistent with research showing that adolescents' regulation strategies are still being differentiated and explored, and that this group may benefit most from targeted intervention.

The high prevalence of intermittent mild anxiety symptoms, despite overall normal range scores, suggests that subclinical anxiety is widespread and represents an important prevention opportunity. This finding supports the development of accessible digital tools for early intervention before symptoms reach clinical thresholds.

5.2 Implications for Practice

These findings have several implications for digital mental health tool design. **First**, the observed age differences underscore the need for age-sensitive approaches; tools should adapt content based on users' developmental stage rather than assuming one-size-fits-all solutions. **Second**, the high prevalence of subclinical anxiety highlights the value of prevention-focused interventions, complementing traditional treatment models. **Third**, the assessment-guidance closed loop demonstrated in this prototype offers a scalable model for reaching populations with limited access to traditional mental health services, particularly in under-resourced settings.

5.3 Limitations

This study has several limitations. **First**, sample representativeness is insufficient. Due to convenience and snowball sampling, the sample may not cover all age groups, occupations, and regions evenly, potentially leading to assessment biases for certain groups. **Second**, the small dataset constrained model performance; classification accuracy may not be optimal, and the suggestion database does not cover all complex emotional states. **Third**, the cross-sectional design captures only a single time point, precluding analysis of dynamic changes or causal relationships, as well as long-term evaluation of agent use.

5.4 Future Research Directions

Future research should address these limitations by: (1) recruiting larger, more representative samples through stratified sampling to enhance generalizability; (2) improving model performance with larger datasets and exploring more sophisticated algorithms beyond rule-based matching; and (3) adopting

longitudinal designs to track emotional changes over time and evaluate the long-term impact of agent use. Additionally, incorporating multimodal data (e.g., text or speech input) and conducting real-world user studies would further validate the approach and inform iterative refinement.

6. Conclusion

This study demonstrates the feasibility of integrating psychological theory with AI technology to construct a multi-group emotion analysis agent. Two main findings emerged from the survey data: emotional resources increased significantly with age, yet subclinical anxiety symptoms were prevalent across all groups. These patterns highlight that emotional health is characterized by both developmental strengths and universal vulnerabilities, underscoring the need for tools that are both age-sensitive and broadly accessible.

The agent prototype successfully translated this insight into an operational assessment-guidance closed loop, validating the technical potential of rule-based matching for personalized emotional support. While the current implementation has limitations, it provides a proof of concept for scalable, low-cost digital interventions that can complement traditional mental health services.

As the field of digital mental health continues to evolve, approaches that are scientifically grounded, contextually adaptive, and designed for diverse populations will be essential. This study represents an initial step in that direction, offering a replicable template for future interdisciplinary work at the intersection of psychology and artificial intelligence.

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Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgment

This paper is an output of the science project.

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