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# The effect of textual language and emojis on others' emotion recognition in social behaviour

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**ABSTRACT**

With the increasing development of digital technology, social media and instant messaging tools have become integral to people's daily lives. Emojis, as a non-verbal addition to textual language, have enriched the emotional depth and expressiveness of digital communication. However, existing research largely overlooks the specific ways emojis contribute to enhancing the receiver's emotional understanding and accurate interpretation, leaving a gap in understanding how text and emojis interact in digital emotional communication. Using experimental design, this study explored the effects of texts and emojis on emotion recognition and communication among online users ($N$ = 40). Results showed that while pure textual language could convey emotional intent, it often led to varied interpretations among receivers (Friedman test for emotional valence across 10 text items: $\chi^2$ (9) = 287.36, $P$ < 0.001, Kendall's W ≈ 0.80; arousal and dominance ns: $\chi^2$ (9) = 10.01, $P$ = 0.35, W ≈ 0.03; $\chi^2$ (9) = 4.72, $P$ = 0.86, W ≈ 0.01. Negative texts were rated as more unpleasant than positive ones (mean valence ≈ 7.45 - 7.80 *vs.* 2.68 - 5.93 on the 1 - 9 scale). In contrast, the addition of emojis clarified the emotional tone of the message, reducing ambiguity and increasing emotional resonance between the sender and receiver (valence: $\chi^2$ (9) = 284.02, $P$ < 0.001, W ≈ 0.79; arousal: $\chi^2$ (9) = 267.46, $P$ < 0.001, W ≈ 0.74; dominance ns: $\chi^2$ (9) = 10.70, $P$ = 0.30, W ≈ 0.03). Overall, emoji-text combinations produced large effects on valence and arousal (W ≈ 0.74 - 0.79), whereas dominance showed no significant change. Our findings underscore the value of emojis in enhancing digital communication and provide practical insights for improving the emotional effectiveness of social media and messaging platforms.

**Key words:** social behaviour, textual language, emojis, emotion recognition

## INTRODUCTION

With the rapid development of information technology, social media and instant messaging have changed the way people communicate, with textual language providing direct verbal information and emojis supplementing or reinforcing the emotional colour of the message through non-verbal means (Hogenboom *et al.*, 2015). Boutet *et al.* (2021) have shown that emojis enhance the emotional clarity of messages, partially resolving the issue of ambiguity caused by the absence of body language and intonation in textual communication. This increased clarity boosts the expressiveness and emotional depth of digital messages (Hand *et al.*, 2022), enabling receivers to interpret the sender's emotions and intentions with greater accuracy (Brants *et al.*, 2019). However, while these studies emphasize the benefits of emojis as emotional cues, they tend to examine emojis or text in isolation. Little attention has been paid to how emojis and textual language jointly influence emotional understanding, leaving a gap in knowledge regarding their interactive effects in digital communication. As people increasingly rely on digital media for daily communication, a deeper understanding

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of the impact of textual language and emojis on emotional communication can be beneficial in facilitating more effective online communication (Surikov & Egorova, 2020; Zou & Xiang, 2022) and enabling social media designers to design communication tools and features that are more responsive to the needs of users (Rezabek & Cochenour, 1998).

Despite the increasing attention to emotional communication online, limited research systematically investigates how textual language and emojis interact to shape emotional perception. Existing studies have often focused on either textual sentiment or emoji-based expression, overlooking how their combination influences emotional interpretation across key affective dimensions such as pleasure, arousal, and dominance. Building upon Mehrabian and Russell's pleasure-arousal-dominance (PAD) model (Mehrabian & Russell, 1974), this study adopts a multidimensional emotional framework to examine how text and emojis jointly affect emotional perception and interpretation in digital communication. These three dimensions are grounded in Mehrabian and Russell's PAD model, which suggests that emotions can be measured along dimensions of pleasure (*i.e.*, emotional valence), arousal (*i.e.*, intensity of emotion), and dominance (*i.e.*, sense of control), offering a nuanced framework for understanding emotional processing in communication (Mehrabian & Russell, 1974). Incorporating these dimensions allows for a more comprehensive examination of how text and emojis affect emotional interpretation, as they account for the strength, activation, and overall positivity or negativity of emotional experiences. Therefore, acknowledging the complexity and diversity of social interactions in the digital era, this study aims to analyze the effects of different texts and emojis on others' emotions through an experimental design in order to provide empirical support for emotional communication in digital communication.

## RESEARCH BACKGROUND

This study aims to bridge the research gap concerning the joint effects of textual language and emojis on emotional understanding. After reviewing the theoretical underpinnings and related works, the following section outlines the research questions and hypotheses that guide this investigation.

### *Textual language*

Distinguished from non-verbal behaviors such as body language, facial expressions, and intonation, textual language is one of the basic, verbal forms of human communication and the most natural carrier of human feelings (Deng & Ren, 2021), which needs to carry more emotions and a great amount of information precisely. In digital platforms, text conveys basic semantic information and carries certain emotional colors and social intentions. The choice of its form and content can influence the receiver's understanding and reaction, determining the effectiveness and quality of communication. With the cross-fertilization of multiple disciplines such as linguistics, psychology and computer science, the choice of vocabulary, syntactic structure and the use of punctuation in textual language can simulate to a certain extent the expression of emotions in face-to-face communication, which can increase the emotional depth of the message and the personalization of the communication (Boll *et al.*, 2024). Textual language formally simplifies the non-verbal elements of communication, and through the richness and adaptability of the language itself, it is able to effectively construct complex emotional and social meanings in digital social behaviors.

### *Emojis*

Emojis provide a unique, non-verbal way of communication by graphically expressing emotions, emphasizing tone or decorating text content. In textual communication environments, emojis bridge the gap of textual language lacking facial expressions and speech, carrying multiple functions similar to facial expressions and body language in communication, and becoming an integral part of daily communication for the younger generation on social media (Coyle & Carmichael, 2019). In the context of the rapid development of social media, over-reliance on emojis tends to lead to the superficiality of communication, resulting in important emotions and intentions being expressed through oversimplified symbols, reducing the richness of language and the depth of expression (Bai *et al.*, 2019). In addition, the same emojis have very different interpretations in different cultural contexts. For example, the 🙏 emoji is commonly used in Western cultures to indicate prayer or gratitude, while in many Asian cultures—especially in Japan—it is often interpreted as a gesture of apology or request. Similarly, the 💩 emoji, although humorous in some Western settings, may be seen as highly offensive or inappropriate in others.

### *The interaction of textual language and emojis in socialization*

Textual language provides the basic framework and logical structure of the message, and emojis add emotional color and non-verbal cues. In social communication, the interaction of textual language and emojis can complement each other, and the directness of the text and the expressiveness of emojis work together to make the communication more comprehensive and precise, thus enhancing the expressive power of the message and the emotional resonance of the receiver (Iqbal *et al.*, 2020). In rapid social media communication, the introduction of emojis can alleviate ambiguities due

to textual language, making otherwise serious or indifferent textual messages friendly and light-hearted (Carroll, 2023). Based on a sociolinguistic perspective, choosing the right combination of textual language and emojis according to the social context can achieve the desired communication effect, influence the interpretation of messages and transfer of emotions (Surikov & Egorova, 2020), and enhance the quality and satisfaction of people's communication (Garrison *et al.*, 2011).

### Emotional communication

Guided by the PAD model, which provides a multidimensional structure for understanding affective responses, this study utilizes the framework to quantify how textual and visual cues shape emotional perception. The model serves as the theoretical basis for developing our research questions and hypotheses presented below. According to the PAD emotional framework proposed by Mehrabian and Russell (1974), emotional experience can be described along three core dimensions: Pleasure, arousal, and dominance. Emotional dominance reflects the degree of control or influence an individual feels they have over a given emotional situation. Higher dominance suggests a sense of empowerment or agency, while lower dominance reflects feelings of being overwhelmed or submissive (Imbir, 2016). Emotional arousal refers to the level of physiological or psychological activation triggered by an emotional state, which ranges from sedated or indifferent (*i.e.*, low arousal) to extremely aroused or tense (*i.e.*, high arousal; Paakkanen *et al.*, 2021). Emotional valence indicates the intrinsic positivity or negativity of an emotional experience. Valence can range from highly positive to highly negative, helping to determine whether the individual perceives a stimulus as enjoyable or distressing, which in turn influences their approach or avoidance behavior (Eerland *et al.*, 2012).

Guided by the PAD model of emotion (Mehrabian & Russell, 1974), this study aimed to investigate how textual language and emojis, both independently and in combination, influence individuals' emotional responses across three core dimensions: Emotional pleasure, emotional arousal, and emotional dominance.

### Research objectives

The main objective of this study is to examine how textual language and emojis interact to shape emotional responses along the dimensions of pleasure, arousal, and dominance. Specifically, it seeks to determine whether emojis enhance emotional clarity and reduce interpretive ambiguity in digital communication.

Research questions: (1) To what extent does textual language alone influence the emotional pleasure, arousal, and dominance of recipients? (2) Does the addition of emojis to textual language significantly alter emotional responses in terms of pleasure, arousal, and dominance? (3) Are emotional responses to messages with emojis more consistent (*i.e.*, show less individual variability) compared to those elicited by textual language alone?

Hypotheses: H1—textual language containing emotional content will significantly affect participants' emotional pleasure, arousal, and dominance ratings. H2—the addition of emojis will enhance the emotional clarity of the message and result in significantly higher emotional pleasure and arousal ratings than text-only messages. H3—emotional dominance ratings will show less variability in emoji-text combinations compared to text-only conditions, indicating greater clarity and control in emotional interpretation.

By addressing these questions, this study seeks to provide deeper insights into how textual and non-verbal cues interact to shape emotional communication in digital environments. The findings may contribute to the design of more effective, emotionally intelligent communication tools for social media and messaging platforms.

## METHODS

### Participants

Forty college students (18 males and 22 females, 22 ± 2 years) were recruited from multiple universities across different cities through online advertisements and university bulletin boards. To ensure randomization, participants who expressed interest were assigned to experimental conditions using a computer-generated random number sequence. A relatively balanced gender distribution was achieved. Inclusion criteria included: (1) Normal or corrected-to-normal vision (self-reported and confirmed through a standard Snellen chart test); (2) right-handedness, as assessed using the Edinburgh Handedness Inventory; and (3) no reported neurological or psychiatric disorders. These criteria were used to minimize variability in perceptual and motor responses during the experiment. Prior to participation, all individuals received a detailed description of the study and signed an informed consent form outlining its purpose, procedures, and ethical assurances. Participation was voluntary, and to thank them for their time and cooperation, participants were given a small token gift after completing the experiment. In addition, the sample size of forty participants was determined based on a priori power analysis using G*Power 3.1 for a within-subjects nonparametric comparison. Assuming a medium effect size ($d = 0.5$), an alpha level of 0.05, and statistical power ($1 - \beta$) = 0.80, the required minimum sample was 34 participants. To ensure robust estimation, the sample size was increased to 40 participants, which satisfies standard recommendations for within-subject affective experiments (Cohen, 1992).

### Measures

Emotional pleasure, emotional arousal, and emotional dominance were measured using the self-assessment manikin (SAM), a widely-used nonverbal pictorial assessment tool developed by Lang (1980) to measure emotional responses across the three dimensions proposed in the PAD model—pleasure, arousal, and dominance. Participants rated their emotional reactions on a 9-point scale, with each point represented by a graphical figure that varied in facial expression, posture, or size to reflect the intensity or polarity of the emotional dimension (Table 1).

The SAM has been shown to have high validity and reliability in affective research (Bradley & Lang, 1994), and its nonverbal nature makes it especially suitable for cross-cultural or linguistically diverse populations, as it avoids the ambiguity of verbal descriptors. Its intuitive visual design allows participants to quickly and accurately express their emotional states without requiring extensive explanation or training.

### Materials

The experiment aimed to simulate common emotional communication in social media environments. Therefore, the experiment selected social media communication scenarios using specially written text messages and observed participants' emotional perceptions and responses to these texts in the absence of non-verbal cues. It also assessed the efficacy of textual language in the absence of non-verbal cues by comparing the effects of the emotional expression of different texts. For the next step, emojis were added to the same textual language used before. The synergistic effect of emojis as non-verbal cues with the textual language was tested, examining whether the addition of emojis enhanced or left the emotional conveyance of messages unchanged.

Representative text language and emojis expressing positive and negative emotions were selected. The text language selected for condition 1 is shown in Table 2.

Condition 2 was based on the textual language of condition 1, with the addition of emojis as shown in Table 3.

### Experimental procedures

In order to more accurately simulate the real-life WeChat environment, the experiment used E-Prime 2.0 software to simulate the daily use of WeChat. In the experiment, participants faced the computer screen. As the first step, a "how are you" greeting appeared on the screen, lasting 1000 milliseconds, in order to establish a basic communication environment and simulate the initial experience of receiving WeChat messages. The second step involved a short attention point, similar to the "+" sign, to help subjects focus. In the third step, a textual language message from Table 2 appeared for 2000 ms, designed to trigger an emotional response. The fourth step was a repetition of the second step to reorient participants to the screen. In the fifth step (condition 2: Text + emoji), the same textual message presented in the third step was shown again, but this time combined with a corresponding emoji, also for 2000 ms. This manipulation was designed to isolate the effect of emojis by keeping the verbal content constant, allowing a direct comparison between participants' emotional responses to the same message with and without non-verbal visual cues.

After each presentation of a text message or a combination of text and emojis, the SAM scale was used to collect their reactions to each message. Through the immediate assessment after each message, the experiment was able to accumulate a large amount of quantitative data on how text messages and emojis affect emotions, providing a solid foundation for subsequent statistical analyses and identification of emotional patterns. The complete experimental procedure is shown in Figure 1.

Throughout the experimental procedure, the duration and content arrangement of each experimental phase were consistent to ensure the consistency and reliability of data collection in order to scientifically assess the specific effects of textual language and emojis on emotional pleasure, emotional arousal, and emotional dominance, and to advance knowledge on the role of textual language and emojis working together to facilitate emotional communication.

### Data analysis

Data collected through the SAM scale was recorded and stored electronically. At the end of the experiment, the data were imported into SPSS software for the next step of analysis. Participants' average emotion scores under different experimental conditions were calculated. Given that preliminary tests (*e.g.*, Shapiro-Wilk) indicated the data violated the assumption of normality, and the SAM scale produces ordinal data on a 9-point scale, a non-parametric test was deemed appropriate. Therefore, the Friedman test was used to compare emotion ratings across experimental conditions. This test does not assume normal distribution and is well-suited for analyzing ranked or ordinal data from repeated measures, allowing for robust examination of whether differences across conditions were statistically significant.

## RESULTS

### Descriptive statistics

Descriptive statistics were performed, presented in

**Table 1: SAM scale**

| Dimensionality | 1 | 5 | 9 |
|---|---|---|---|
| Emotional valence | Very pleasant | Neutral | Very unpleasant |
| Emotional arousal | Very excited | Neutral | Very calm |
| Emotional dominance | Totally in control | Neutral | Totally in control |

SAM, self-assessment manikin.

**Table 2: Text language for condition 1**

| Textual language of positive emotions | The textual language of negative emotions |
|---|---|
| Today the game was won | Had a headache all day today |
| I finished my project today | My new car was hit |
| The leader praised me today | I've been under a lot of stress lately |
| It's a beautiful day today | I am always behind everyone else |
| I finally succeeded in losing weight | I have insomnia every night |

**Table 3: Combination of textual language + emojis for condition 2**

| Textual language of positive emotions + emojis | Textual language of negative emotions + emojis |
|---|---|
| Today the game was won😃 | Had a headache all day today😔 |
| I finished my project today☺️ | My new car was hit😰 |
| The leader praised me today😊 | I've been under a lot of stress lately😟 |
| It's a beautiful day today😊 | I am always behind everyone else😫 |
| I finally succeeded in losing weight😩 | I have insomnia every night😯 |

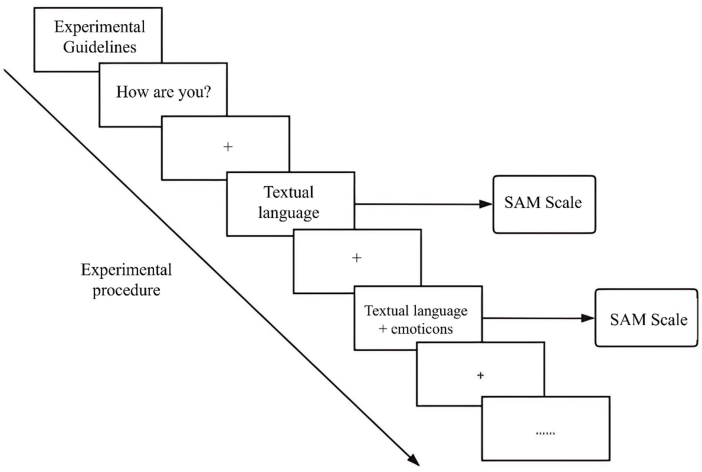


**Figure 1.** Experimental procedure. SAM, self-assessment manikin.

Table 4 and Figure 2. For the positive texts, the emotional valence scores showed slightly greater variability (mean standard deviation [SD] = 1.26) compared to the negative texts (mean SD = 1.17). The emotional valence of the negative texts was relatively more concentrated and consistent, reflecting a consensus on negative emotions. Specifically, the mean valence scores for the five negative texts ranged from 7.45 to 7.80, with standard deviations between 1.01 and 1.26, and all minimum ratings at or above 6. Statistically, the standard deviation of the "emotional valence" in the positive texts was relatively high, with values ranging from 0.694 to 1.474, and an average SD of approximately 1.26 across the five positive messages. It indicates a greater

**Table 4: Textual linguistic descriptive statistics**

| Textual language | Dimension | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Today the game was won | Emotional valence | 1 | 5 | 3.30 | 1.32 |
| | Emotional arousal | 1 | 9 | 4.45 | 2.78 |
| | Emotional dominance | 1 | 9 | 5.08 | 2.78 |
| I finished my project today | Emotional valence | 1 | 5 | 3.10 | 1.36 |
| | Emotional arousal | 1 | 9 | 5.18 | 2.65 |
| | Emotional dominance | 1 | 9 | 4.85 | 2.32 |
| The leader praised me today | Emotional valence | 1 | 5 | 2.68 | 1.47 |
| | Emotional arousal | 1 | 9 | 5.13 | 2.64 |
| | Emotional dominance | 1 | 9 | 5.50 | 2.43 |
| It's a beautiful day today | Emotional valence | 1 | 5 | 3.25 | 1.45 |
| | Emotional arousal | 1 | 9 | 5.08 | 2.47 |
| | Emotional dominance | 1 | 9 | 5.08 | 2.78 |
| I finally succeeded in losing weight | Emotional valence | 5 | 7 | 5.93 | 0.69 |
| | Emotional arousal | 1 | 9 | 4.50 | 2.62 |
| | Emotional dominance | 1 | 9 | 4.27 | 2.72 |
| Had a headache all day today | Emotional valence | 6 | 9 | 7.80 | 1.13 |
| | Emotional arousal | 1 | 9 | 4.20 | 2.55 |
| | Emotional dominance | 1 | 9 | 4.78 | 2.33 |
| My new car was hit | Emotional valence | 6 | 9 | 7.80 | 1.16 |
| | Emotional arousal | 1 | 9 | 4.65 | 2.53 |
| | Emotional dominance | 1 | 9 | 5.18 | 2.65 |
| I've been under a lot of stress lately | Emotional valence | 6 | 9 | 7.60 | 1.26 |
| | Emotional arousal | 1 | 9 | 5.42 | 2.79 |
| | Emotional dominance | 1 | 9 | 4.88 | 2.32 |
| I am always behind everyone else | Emotional valence | 6 | 9 | 7.60 | 1.15 |
| | Emotional arousal | 1 | 9 | 5.37 | 2.36 |
| | Emotional dominance | 1 | 9 | 4.97 | 2.99 |
| I have insomnia every night | Emotional valence | 6 | 9 | 7.45 | 1.15 |
| | Emotional arousal | 1 | 9 | 4.57 | 2.61 |
| | Emotional dominance | 1 | 9 | 5.20 | 2.68 |

SD, standard deviation.

dispersion of ratings, while the standard deviation of the "emotional valence" in the negative texts was low, showing a high degree of consistency in the negative emotional responses.

For the analysis of emotional arousal and emotional dominance, the data showed that the emotional arousal and emotional dominance scores of all text languages included the full range from 1 to 9. This indicated that both positive and negative texts showed great individual differences in the degree of emotional arousal and sense of control.

Descriptive statistics for condition 2, including combinations of textual language and emojis, were shown in Table 5 and Figure 3. The mean value of emotional dominance of positive texts was generally between 4.68 and 4.85, suggesting that participants experienced a moderate sense of control or agency in response to positive text-emoji combinations. The mean value of negative texts was generally between 7.37 and 7.57, indicating that the combination of negative texts and negative emojis triggered negative emotional resonance. For emotional arousal, the combinations of positive texts and positive emojis showed a relatively consistent standard deviation, suggesting that positive emotional arousal levels were more uniform across participants.

### *Emotional response analysis*

Based on the data collected in the experiment, a Friedman test was conducted on the three emotional dimensions defined in the PAD model—emotional valence, emotional arousal, and emotional dominance—to examine whether the different message types (text-only and text + emoji) elicited statistically significant differences in emotional responses. The test results are presented in Table 6. Results of the Friedman test showed that differences in emotional pleasure between different text languages were significant, $\chi^2$ (9) = 287.36,

**Table 5: Textual language + emoji descriptive statistics**

| Text language + emojis | Dimension | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Today the game was won😃 | Emotional valence | 1 | 5 | 2.80 | 1.38 |
| | Emotional arousal | 1 | 5 | 3.12 | 1.38 |
| | Emotional dominance | 4 | 6 | 4.77 | 0.53 |
| I finished my project today☺️ | Emotional valence | 1 | 5 | 3.20 | 1.51 |
| | Emotional arousal | 1 | 5 | 2.70 | 1.45 |
| | Emotional dominance | 4 | 6 | 4.68 | 0.53 |
| The leader praised me today😊 | Emotional valence | 1 | 5 | 2.98 | 1.37 |
| | Emotional arousal | 1 | 5 | 3.05 | 1.28 |
| | Emotional dominance | 4 | 6 | 4.75 | 0.59 |
| It's a beautiful day today😊 | Emotional valence | 1 | 5 | 3.00 | 1.45 |
| | Emotional arousal | 1 | 5 | 3.18 | 1.20 |
| | Emotional dominance | 3 | 6 | 4.80 | 0.61 |
| I finally succeeded in losing weight😩 | Emotional valence | 1 | 5 | 3.18 | 1.39 |
| | Emotional arousal | 1 | 5 | 3.15 | 1.33 |
| | Emotional dominance | 4 | 6 | 4.85 | 0.53 |
| Had a headache all day today😔 | Emotional valence | 6 | 9 | 7.45 | 1.15 |
| | Emotional arousal | 5 | 8 | 6.45 | 0.88 |
| | Emotional dominance | 4 | 7 | 4.93 | 0.66 |
| My new car was hit😰 | Emotional valence | 6 | 9 | 7.50 | 1.26 |
| | Emotional arousal | 5 | 9 | 6.70 | 1.31 |
| | Emotional dominance | 3 | 6 | 4.90 | 0.59 |
| I've been under a lot of stress lately😨 | Emotional valence | 6 | 9 | 7.37 | 1.08 |
| | Emotional arousal | 5 | 9 | 6.52 | 1.22 |
| | Emotional dominance | 4 | 6 | 4.90 | 0.59 |
| I am always behind everyone else😫 | Emotional valence | 6 | 9 | 7.57 | 1.01 |
| | Emotional arousal | 5 | 9 | 6.48 | 1.24 |
| | Emotional dominance | 4 | 6 | 4.88 | 0.61 |
| I have insomnia every night😵 | Emotional valence | 6 | 9 | 7.55 | 1.18 |
| | Emotional arousal | 5 | 9 | 6.45 | 1.34 |
| | Emotional dominance | 4 | 6 | 4.75 | 0.54 |

SD, standard deviation.

$P < 0.001$. The statistical significance stemmed from the direct effect of the textual content on the emotional impact of the participants. Findings suggested that textual language itself conveyed emotions and influenced the perception of emotions on the receiver's end. Negative texts were more likely to elicit strong emotional responses. For emotional arousal and emotional dominance, the test results showed that they were not statistically significant.

For the conditions involving a combination of textual language and emojis, an emotional pleasure judgment test was conducted using the Friedman test in SPSS, with results shown in Table 7. The test indicated a significant effect of emotional pleasure, with a chi-square value of $\chi^2 = 284.016$ and a very low asymptotic significance, suggesting a high level of statistical significance across different combinations. This finding suggested that the integration of textual language and emojis contributed significantly to perceived emotional pleasure. For emotional arousal, the chi-square value was $\chi^2 = 267.455$, with an asymptotic significance of $P < 0.001$, indicating a highly significant effect. This result implies that combining textual language with emojis can effectively arouse emotions, where positive language and emojis often evoke pleasurable emotions, while negative elements mobilize alertness and cognitive resources. In contrast, emotional dominance did not reach statistical significance, with a *P*-value of 0.297, suggesting that the sense of control within the emotional experience was not significantly impacted by the combination of textual language and emojis.

### *Emotional response analysis of sentences with and without emoji*

For each sentence, we contrasted its emoji-augmented version with its text-only counterpart and computed the difference $\Delta = \text{Mean}_{\text{Emoji}} - \text{Mean}_{\text{Text}}$ on the SAM scales. Interpreting SAM anchors (lower valence = more

**Table 6: Text language Friedman test results**

| Textual language | Emotional valence | | | Emotional arousal | | | Emotional dominance | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Rank average | Mean | SD | Rank average | Mean | SD | Rank average |
| Today the game was won | 3.30 | 1.32 | 2.61 | 4.45 | 2.78 | 4.88 | 5.08 | 2.78 | 5.69 |
| I finished my project today | 3.10 | 1.36 | 2.55 | 5.18 | 2.65 | 5.91 | 4.85 | 2.32 | 5.21 |
| The leader praised me today | 2.68 | 1.47 | 2.23 | 5.13 | 2.64 | 5.98 | 5.50 | 2.43 | 5.90 |
| It's a beautiful day today | 3.25 | 1.45 | 2.71 | 5.08 | 2.47 | 5.74 | 5.08 | 2.78 | 5.61 |
| I finally succeeded in losing weight | 5.93 | 0.69 | 5.58 | 4.5 | 2.62 | 5.13 | 4.27 | 2.73 | 4.70 |
| Had a headache all day today | 7.80 | 1.14 | 8.06 | 4.2 | 2.55 | 4.79 | 4.78 | 2.33 | 5.44 |
| My new car was hit | 7.80 | 1.16 | 8.07 | 4.65 | 2.53 | 5.13 | 5.18 | 2.65 | 5.54 |
| I've been under a lot of stress lately | 7.60 | 1.26 | 7.84 | 5.42 | 2.79 | 6.01 | 4.88 | 2.32 | 5.51 |
| I am always behind everyone else | 7.45 | 1.15 | 7.83 | 5.37 | 2.36 | 6.04 | 4.97 | 2.99 | 5.59 |
| I have insomnia every night | 7.60 | 1.15 | 7.53 | 4.57 | 2.61 | 5.41 | 5.20 | 2.68 | 5.81 |
| Chi-square (math.) | 287.363 | | | 10.006 | | | 4.717 | | |
| Degree of freedom | 9 | | | 9.000 | | | 9.000 | | |
| Asymptotic significance | < 0.001 | | | 0.350 | | | 0.858 | | |

SD, standard deviation.

**Table 7: Textual language + emoji friedman test results**

| Text language + emojis | Emotional valence | | | Emotional arousal | | | Emotional dominance | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Rank average | Mean | SD | Rank average | Mean | SD | Rank average |
| Today the game was won😃 | 3.25 | 1.41 | 3.18 | 3.05 | 1.36 | 3.15 | 4.70 | 0.56 | 4.74 |
| I finished my project today😌 | 3.05 | 1.38 | 3.03 | 2.98 | 1.29 | 2.96 | 4.88 | 0.46 | 5.49 |
| The leader praised me today😊 | 2.83 | 1.50 | 2.71 | 3.05 | 1.28 | 2.95 | 4.85 | 0.53 | 5.36 |
| It's a beautiful day today😊 | 3.23 | 1.35 | 3.23 | 3.18 | 1.20 | 3.20 | 4.88 | 0.61 | 5.46 |
| I finally succeeded in losing weight😐 | 2.85 | 1.49 | 2.86 | 3.15 | 1.33 | 3.14 | 4.82 | 0.50 | 5.29 |
| Had a headache all day today😔 | 7.45 | 1.15 | 7.96 | 6.45 | 0.88 | 7.94 | 5.00 | 0.45 | 5.99 |
| My new car was hit😰 | 7.35 | 1.08 | 7.89 | 6.70 | 1.31 | 8.20 | 5.00 | 0.56 | 6.00 |
| I've been under a lot of stress lately😰 | 7.82 | 1.17 | 8.43 | 6.52 | 1.22 | 7.94 | 4.75 | 0.54 | 5.09 |
| I am always behind everyone else😩 | 7.20 | 1.11 | 7.79 | 6.48 | 1.24 | 7.74 | 4.98 | 0.62 | 5.73 |
| I have insomnia every night😵 | 7.40 | 1.03 | 7.94 | 6.45 | 1.34 | 7.79 | 4.97 | 0.62 | 5.86 |
| Chi-square (math.) | 284.016 | | | 267.455 | | | 10.697 | | |
| Degree of freedom | 9 | | | 9 | | | 9 | | |
| Asymptotic significance | < 0.001 | | | < 0.001 | | | 0.297 | | |

SD, standard deviation.

pleasant; lower arousal = more activated), a negative Δ in valence indicates greater pleasantness and a negative Δ in arousal indicates higher activation.

Positive sentences ($N$ = 5): Median $\Delta_{Valence}$ ≈ -0.05 (range -2.75 to +0.15), median $\Delta_{Arousal}$ ≈ -1.90 (range -2.20 to -1.35), median $\Delta_{Dominance}$ ≈ -0.20 (range -0.65 to +0.58). Thus, adding positive emojis made the same sentence slightly more pleasant and notably more activated, with a small, inconsistent shift in dominance.

Negative sentences ($N$ = 5): Median $\Delta_{Valence}$ ≈ -0.23 (range -0.35 to +0.10), median $\Delta_{Arousal}$ ≈ +1.88 (range +1.10 to +2.25), median $\Delta_{Dominance}$ ≈ -0.09 (range -0.45 to +0.15). Thus, adding negative emojis tended to make the same sentence slightly less unpleasant while reducing activation (*i.e.*, higher arousal scores = calmer).

All sentences combined ($N$ = 10): Median $\Delta_{Valence}$ ≈ -0.05, median $\Delta_{Arousal}$ ≈ -0.13, median $\Delta_{Dominance}$ ≈ -0.15. The near-zero overall arousal shift reflects opposite directions for positive *vs.* negative items.

## DISCUSSION

### *Text-emoji combinations and emotional resonance*

In modern social behavior, emojis serve as powerful non-verbal cues that can intuitively express or amplify the emotional tone of textual messages. When paired

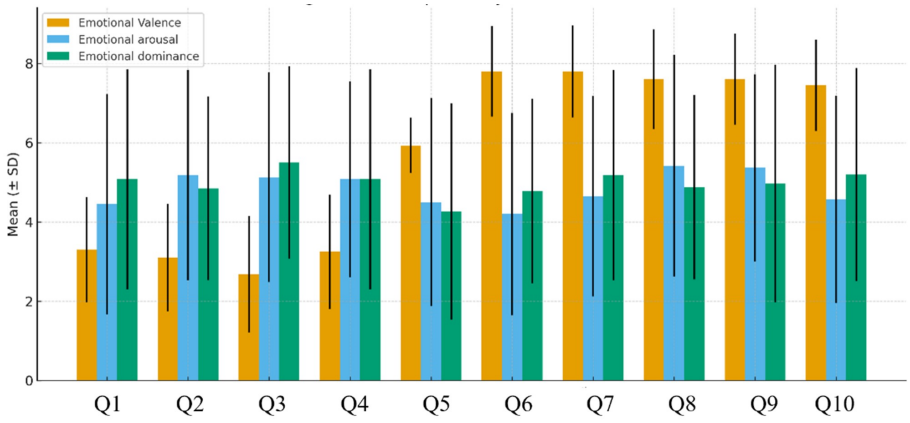


**Figure 2.** Textual linguistic descriptives by sentences and dimensions. The sentence labels in the figure correspond to the following items: Q1—today the game was won; Q2—i finished my project today; Q3—the leader praised me today; Q4—it's a beautiful day today; Q5—i finally succeeded in a difficult task; Q6—i had a headache all day today; Q7—my new car was hit; Q8—i've been under a lot of stress; Q9—i am always behind everything; Q10—i have insomnia every night. SD, standard deviation.

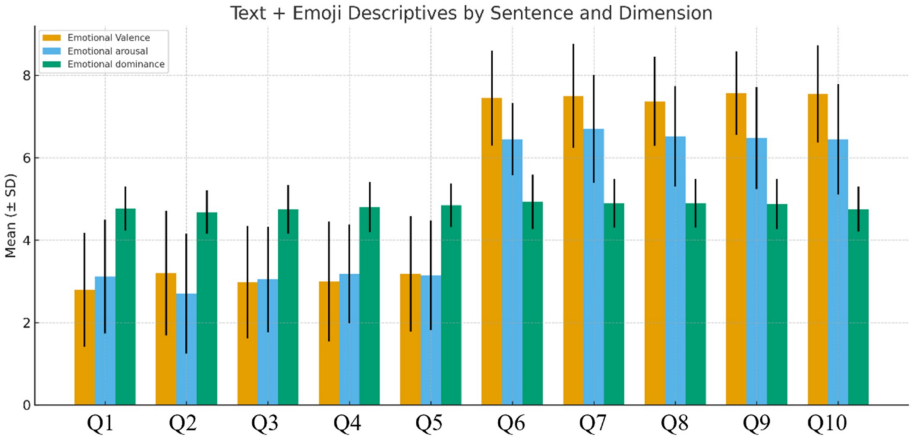


**Figure 3.** Text + emoji descriptives by sentences and dimensions. The sentence labels in the figure correspond to the following items: Q1—today the game was won; Q2—i finished my project today; Q3—The leader praised me today; Q4—it's a beautiful day today; Q5—i finally succeeded in a difficult task; Q6—i had a headache all day today; Q7—my new car was hit; Q8—i've been under a lot of stress; Q9—i am always behind everything; Q10—i have insomnia every night. SD, standard deviation.

with text, emojis provide visual salience, enabling quicker and clearer emotional interpretation, especially in fast-paced environments like social media and instant messaging. This multimodal form of communication, combining the clarity of language with the emotive nuance of emojis, adds depth and complexity to digital interactions. By reducing ambiguity in emotional expression, emojis enhance emotional resonance, allowing receivers to sense the sender's emotional state and respond in a more empathetic and contextually appropriate way. Thus, the addition of emojis promotes interactive communication, improves emotional satisfaction, and strengthens social intimacy, fostering deeper interpersonal connections (Aldunate & González-Ibáñez, 2017; Kaye *et al.*, 2016).

These findings are consistent with prior multimodal communication theories suggesting that emotional icons and visual cues function as paralinguistic signals that supplement linguistic meaning (Derks *et al.*, 2008; Dresner & Herring, 2010). Similar to facial expressions in face-to-face communication, emojis bridge the gap between text and emotion, thereby supporting the social presence and media richness theories (Short *et al.*, 1976), which posit that richer media forms lead to more effective emotional exchanges.

### *Reaction time and emotional processing*

The study found that participants reacted faster to positive messages, like "i won the race today", than to emotionally charged negative ones, such as "my new car has been hit." Negative messages required longer response times, likely due to personal associations and cognitive demands related to negative emotions, which can trigger an emotional overload (Ladouceur *et al.*, 2006; Pessoa *et al.*, 2012). From the perspective of emotional dominance, high levels of dominance allow

individuals to regulate emotions more efficiently, thereby reducing response times, while low levels of dominance extend processing time. These findings highlight the impact of emotional dominance on cognitive processing, suggesting that high emotional control enhances processing speed and reaction efficiency (Koch *et al.*, 2018). Exploring this relationship further may provide insights into individual differences in emotional regulation, offering a metric to assess emotional regulation efficiency in contexts requiring rapid emotional processing (Blair *et al.*, 2007; Zinchenko *et al.*, 2017). Comparable results have been observed in affective neuroscience studies, where negative stimuli induced longer latency in affective decision tasks due to enhanced amygdala-prefrontal engagement (Dolcos & McCarthy, 2006; LeDoux, 2014). This alignment reinforces the notion that emotional regulation capacity modulates both neural efficiency and behavioral response time.

### Emotional PAD in textual language

The quantitative analysis revealed that positive and negative texts elicited significantly different levels of emotional valence, with negative texts consistently rated as more unpleasant. Moreover, negative texts also tended to elicit higher levels of emotional arousal, indicating stronger physiological or psychological activation in participants. This pattern aligns with prior findings that negative language is often associated with personal memories or cognitive biases, which can trigger deeper emotional processing and heightened alertness (Chow *et al.*, 2021). The variation in emotional pleasure suggests that textual information alone can significantly influence emotional arousal. Interestingly, emotional arousal and dominance did not reach statistical significance, potentially due to personal factors such as prior experiences and individual empathy levels (Zhang *et al.*, 2022). These findings suggest that the emotional responses triggered by textual content are complex and multidimensional, revealing the nuanced role of personal context in shaping emotional reactions.

Previous work on affective valence has similarly shown that negative stimuli are more attention-grabbing and arousing than positive ones (Baumeister *et al.*, 2001; Ito *et al.*, 1998). Such asymmetry supports the "negativity bias" theory, which posits that humans are evolutionarily predisposed to respond more strongly to negative information. The present results expand this understanding into the textual domain, suggesting that even language-based stimuli can evoke this bias.

### Impact of emojis on emotional clarity and processing efficiency

As opposed to text-only communication, the use of emojis with textual language enhances the clarity and accuracy of emotional expression by making emotional intent explicit. Smiley emojis, for example, amplify positive sentiments, while sad emojis reduce uncertainty in emotional interpretation (Logi & Zappavigna, 2023; Pfeifer *et al.*, 2022). The findings support the multimodal dominance hypothesis (Lou *et al.*, 1038), showing that text combined with emojis enables faster emotional recognition and processing. This rapid emotional recognition facilitates the efficient allocation of cognitive resources, thereby improving overall processing speed (Cao *et al.*, 2024). Particularly in environments with large amounts of information, emojis serve as anchors that expedite information decoding, enhancing the alignment of new information with prior knowledge and emotional states, which is crucial for effective social media and instant messaging interactions.

Comparable to the dual-coding theory (Paivio, 1991), the presence of visual symbols like emojis activates both verbal and non-verbal processing systems, thereby enhancing memory and comprehension efficiency. In line with cognitive load theory (Sweller, 1988), emojis may also reduce intrinsic load by clarifying affective intent, allowing for faster semantic integration. This synergy between verbal and visual cues explains why emojis significantly enhance emotional clarity and cognitive efficiency.

### Implications for emotional regulation and practical applications

These findings underscore the potential of emojis and text-emoji combinations as tools for enhancing intuitive emotional communication. However, reliance on emojis alone may oversimplify complex emotions, as people may prefer simple symbols over in-depth text in challenging emotional contexts (Provine *et al.*, 2007; Sarkar *et al.*, 2014). For this reason, the strategic use of both text and emojis is recommended to maintain the depth of emotional expression in digital interactions. Additionally, understanding the role of emotional dominance in processing speed highlights practical applications in education and mental health, where enhancing emotional regulation can improve cognitive efficiency in emotion-laden tasks. Comparable applications have been noted in emotional intelligence training and affective computing, where multimodal emotional cues are leveraged to improve user empathy and adaptive feedback (Picard, 2010; Cowie *et al.*, 2001). Integrating such findings could inform AI-mediated communication systems, helping machines interpret and convey emotional nuance more effectively. Future research could explore diverse statistical approaches to further validate these findings, providing a more comprehensive analysis of how multimodal communication influences emotional perception and processing.

Despite the valuable findings, this study has several

limitations that should be acknowledged. First, the sample consisted solely of college students, which may limit the generalizability of the results to broader populations with different age groups, cultural backgrounds, or digital communication habits. Future studies should aim to recruit more diverse participants to examine whether similar emotional responses are observed across demographic groups. Second, the experiment relied on a relatively small number of pre-selected textual messages and emojis, which may not fully capture the complexity and richness of real-life digital communication. Emotional interpretations in naturalistic settings may be influenced by context, message history, and user familiarity, factors not fully simulated in this study. Third, although the SAM is a well-validated tool for measuring emotional responses, it is a self-report measure and may be subject to biases such as social desirability or lack of introspective accuracy. Combining self-report with physiological or behavioral data (*e.g.*, heart rate, reaction time, eye-tracking) could enhance measurement reliability in future research. Finally, the statistical analysis used non-parametric tests due to the ordinal nature of the data and the small sample size. While appropriate, this method limits the complexity of modeling potential interactions or covariates. Future work with larger samples could employ mixed-effects models or multivariate approaches to explore deeper patterns.

### *Within-item paired analysis of emoji effects*

These within-item, within-subject contrasts provide a direct estimate of the emoji effect on the same sentence. For positive content, emojis made messages slightly more pleasant and more engaging, consistent with the idea that positive emojis amplify positive effects. For negative content, emojis produced small reductions in unpleasantness and lower activation (calmer responses), suggesting a stabilizing or clarifying role in negative contexts. Changes in dominance were small and inconsistent, indicating limited influence on perceived control. This bidirectional modulation aligns with the emotional congruence hypothesis (Nabi, 2003), which suggests that congruent affective cues strengthen, while incongruent cues dampen, emotional resonance. Thus, emojis appear to not only signal emotion but also regulate the emotional tone of textual interactions.

## CONCLUSION AND RECOMMENDATIONS

### *Recommendations*

#### *Integration of emotional labelling systems*

Integrating an emotion tagging system on social media and communication platforms can enhance the efficiency and accuracy of communication by analysing the textual content sent by users through natural language processing (NLP) technology, automatically identifying the emotional tendencies in it, and recommending corresponding emojis or emotion tags to enhance the emotional expressiveness of the message and the emotional resonance of the receiver (Al-Azani & El-Alfy, 2021). By collecting and analyzing the emojis and text content chosen by users in different contexts, the system can model the users' emotional patterns and thus provide more personalized services, which is conducive to enhancing the stickiness of users, attractiveness of the platform, user satisfaction, and the social responsibility of the platform (Aadil & Samad, 2023).

#### *Improvement of personal communication skills*

With the popularity of social media and instant messengers, people need to express their thoughts and feelings clearly and interpret each other's messages accurately (Sari, 2021). To do this, people need to learn to use appropriate language and set expectations that match the context and purpose of communication. For example, using professional and polite language in formal business communication and more relaxed and friendly language in informal social situations. With the diversification of communication methods, people should learn to effectively combine various media, such as text, emojis, pictures, and videos, to express complex emotions and messages and to enhance the expressive and contagious power of their messages. When they improve their communication efficiency, they may adapt better and faster to the ever-changing communication environment, enhancing their personal competitiveness and social competence.

## CONCLUSION

This study explores the effects of textual language and emojis on the receiver's emotional perception through an experimental design. The experimental results show that the use of pure textual language can influence others' emotions, which is conducive to improving the efficiency of expressing and receiving emotional information. The combination of textual language and emojis reduces the ambiguity of emotional interpretation and enhances emotional resonance. This improvement increases the accuracy of emotional pleasure and the sensitivity of emotional arousal, thereby enhancing emotional satisfaction in communication. Furthermore, these findings are beneficial for optimizing online communication strategies and provide valuable insights for designers in creating emotion-sensitive human-computer interfaces.

## DECLARATION

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### *Author contributions*

Qin X: Conceptualization, Methodology, Formal

analysis, Writing—Original draft preparation, Visualization, Funding acquisition. Han X: Data curation, Software, Validation, Investigation, Writing—Review and Editing, Supervision, Project administration.

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### *Informed consent*
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### *Conflict of interest*
The author has no conflicts of interest to declare.

### *Use of large language models, AI and machine learning tools*
No AI tools were used.

### *Data availability statement*
All data has been included in this paper.

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